Illinois Statewide Travel Demand Model

BEST PRACTICES FOR STATEWIDE MODEL DEVELOPMENT IN COLLABORATION WITH LOCHMUELLER GROUP AND CDM SMITH

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List of Abbreviations

AADT..... Average Annual Daily Traffic
ACS..... American Community Survey
ARNOLD..... All Road Network of Linear Referenced Data
CMAP ..... Chicago Metro Agency for Planning
FAF4..... Freight Analysis Framework Version 4
FCLASS ..... Functional Classification
HCV..... Heavy Commercial Vehicles
ID ..... Identification Number
IDOT ..... Illinois State Department of Transportation
IL..... Illinois
ILLDM..... Illinois Long Distance Passenger and Freight Truck Travel Modeling
ILSTDM ..... Illinois Statewide Travel Demand Model
LEHD..... Longitudinal Employer Household Dynamic
MPO..... Metropolitan Planning Organization
NAICS..... North America Industry Classification System
TDM..... Travel Demand Model
TAZ ..... Traffic Analysis Zone
VPD..... Vehicle Per Day
VPL.....Vehicles Per Lane

Section 1

Introduction

From Los Angeles to Tokyo, rising traffic congestion is an inescapable condition in large and growing metropolitan areas across the world. Efficient operation of the economy and our school systems requires that people go to work, go to school, and run errands during about the same hours so they can interact with each other (Downs, 2004). We cannot alter that basic requirement without crippling our economy and society. This problem marks every major metropolitan area in the world.

Travel demand models (TDM) are used to forecast traffic flows on the transportation system. Although the transportation system may include other modes of travel such as walking, bikes, or trains, these models are typically used for evaluating roadway improvements for vehicles or developing improvements to transit services.

TDMs are generally used for long range forecasts of 20 to 30 years. TDMs are used by consulting firms, metropolitan planning organizations (MPOs), and state departments of transportation (DOTs) to identify possible future-year transportation system deficiencies that may not exist today. These agencies also use TDMs to evaluate the impacts of alternative transportation solutions for development of long-range transportation plans. TDMs are used as the basis for "Certified Traffic" forecasts, for pollution emission estimates, and for congestion management system statistics[1].

Why Develop a Statewide Travel Demand Model?

Statewide models are becoming increasingly common as states struggle with complex transportation issues that must be studied from a system perspective. MPOs typically use the urban area as their unit of analysis. As a result, the forecasts and the analysis of infrastructure needs originating from this process is limited by the boundaries of their urban areas. Because of this practice, a significant proportion of passenger travel is not modeled directly in MPO models, given that 34% of all person miles traveled come from long-distance trips that cross MPO boundaries (NHTS 2009). Additionally, freight trucks account for 10% of vehicle miles traveled (NTS 2011) but are generally overlooked in the TDM process.

Hence, statewide travel demand modeling provides the opportunity to evaluate a larger transportation system in an integrated framework. It offers a better understanding of travel behavior across the state and covers areas beyond MPO borders. It also helps with better planning of transportation services for automobiles and transit and is an approach towards more efficient infrastructure planning and management for the safety, economic development and land-use.

OUTLINE

The future operations of transportation systems involve a lot of uncertainty. Modeling these complicated systems requires many variables and behavioral components whose variability may be poorly identified or simply ignored. Large-scale transport demand models are estimated sequentially, with the results or estimates of one model acting as inputs to subsequent models (Ottomanelli). Without explicit and rigorous data collection techniques and formation of uniform framework, uncertainty in transportation demand forecasts, transportation planning of towns, cities, and metropolitan areas takes on uncertainties. Transportation plans and polices based on these forecasts may be inaccurate and even misleading. As a result, transport facility investments may be poorly directed.

TAZ and Network Development is the initial step in the conventional four-step transportation forecasting process (followed by Trip Generation, Distribution, Mode Choice, and Trip Assignment), widely used for forecasting travel demands (Gonzalez, n.d.). If best practices are adopted from the very first step, the results or estimates of this step acting as inputs to subsequent steps can reduce the errors significantly.

Developers and users of statewide models can point to the best features of different statewide TDMs, and a considerable amount of research is underway to improve them. It is difficult to portray a typical statewide TDM and use it to exemplify best practices. Compared to traditional TDMs, statewide TDMs address a wider range of requirements, cover much larger areas, and focus on different geographies that are not well understood (Schiffer, 2005). This capstone attempts to overcome this limitation by describing how the Illinois Statewide Travel Demand Model has been developed from the very initial step and the resources required to do so.

Therefore, this capstone project will focus on documenting the process and developing a manual for best practices (TAZ boundaries, data aggregation and segregation, establishing uniform framework and methodology) focusing primarily on TAZ and Network Development in the context of Statewide Travel Demand Model.

Section 2
Network Development

This section of the report presents the development of the geography and attributes for the ILSTDM highway network both inside and outside of the state of Illinois. The areas of the ILSTDM geographic structure are as follows:

1. In-state: within the state of Illinois
2. Halo: outside the state of Illinois within an approximately 50-mile buffer
3. National: outside the state of Illinois beyond the halo area and covering the United States

2.1 Inside Illinois

2.1.1 Geography

The geography of the network within the state of Illinois (IL) is developed using the HERE street network data. The methodology starts by flagging all street links in the HERE network with a functional class of major collector and higher to be included in the network. In addition, links that provide connectivity in the network and links with an annual average daily traffic (AADT) of 1,000 vehicles per day (vpd) were added to the network links.

During the development of the highway network in rural areas within the state, the All Road Network of Linear Referenced Data (ARNOLD) highway layer from 2017 was referenced and used to supplement the HERE network for links with a functional class of major collector and higher, and links with AADT greater than a 1,000 vpd. Another network source used in the development of the network links was the Illinois Long Distance Passenger and Freight Truck Travel Modeling (ILLDM) network. Links were incorporated into the rural portions of the ILSTDM network based on their presence in the ILLDM. Global checks were performed to make sure all major facilities including interstates, freeways, and principal arterials were included in the rural area network.

The developed ILSTDM network was merged with the ILSTDM network developed for the Metropolitan Planning Organizations (MPO) jurisdictions. The Chicago Metro Agency for Planning (CMAP) region of the ILSTDM network uses a one-to-one import of the 2015 CMAP model network. The remaining MPO areas in the state are described in section 2.1.5 Adoption of Regional Models.

2.1.2 Centroid Connectors

Centroid connectors were added to the roadway links of the ILSTDM. The process of adding centroid connectors to roadway links inside IL and outside IL (Halo and National areas) is similar. Standard rules were followed in adding the centroid connectors. Centroid connectors were added mid-block

of the ILSTDM roadway segments. The following settings were applied during the automated centroid connector process:

- Restriction of the centroid connectors within the TAZ area to ensure that connectors do not cross over TAZ boundaries.
- Exclusion of interstates and freeways, ramps, and one-way links.
- A maximum connection distance of 25 miles for the in-state zones.
- A maximum of 3 centroid connectors per zone.

In addition, centroid connectors were not added to 80 of the zones because there were no roads inside these TAZs or because there were only freeways and/or one-way links inside these TAZs. To correct this, minor arterial, major collectors, or minor collectors were added to these TAZs using Google Earth imagery as a reference, and then centroid connectors were added manually to connect the zone centroid to these added roadways.

Lastly, attributes were populated for all centroid connector links in the network as summarized in **Table 2-1.**

Table 2-1: Centroid Connector Attributes for In-State Centroid Connector Links

Variable	Description
ST_NAME	Centroid Connector
FCLASS	98
FCLASS_DESCRIPTION	Internal Centroid Connector
TOTAL LANES	20
AB_LANES	10
BA_LANES	10
SPEEDLIMIT	35 mph
MEDIAN_TYPE	Undivided

Figure 2-1 shows the example of centroid connectors in CMAP area. Note that while the CMAP highway network was directly used, the centroid connectors in the CMAP network were not used.

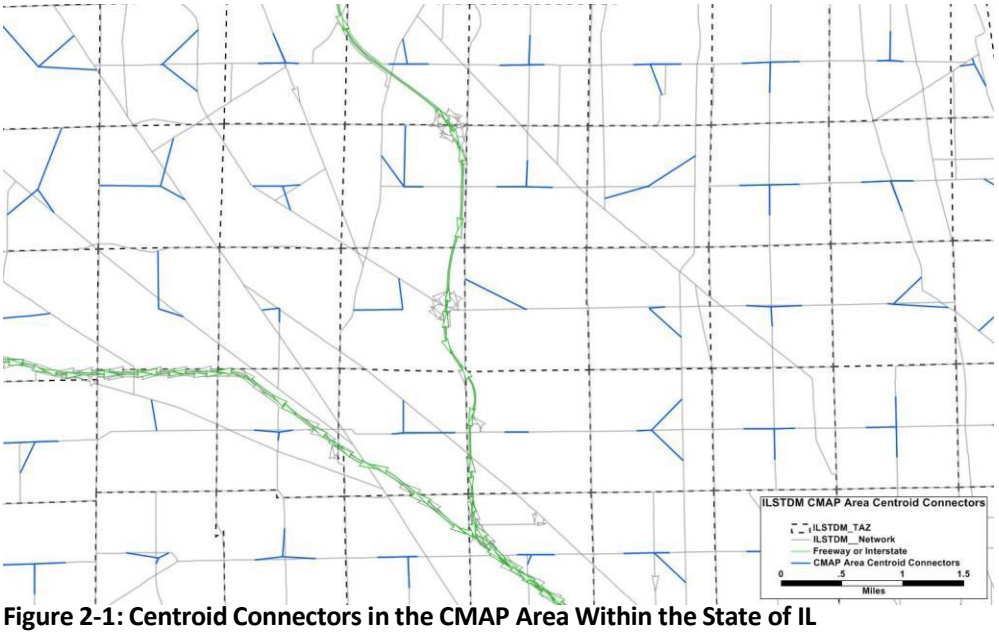


Figure 2-1: Centroid Connectors in the CMAP Area Within the State of IL

2.1.3 In-State Roadway Attributes

Basic roadway attributes were developed for the ILSTDM network. These basic attributes are provided in **Table 2-2** along with a description of each attribute.

Table 2-2: Roadway Attributes

Attribute	Values / Description
Directionality	1 or -1 for One-way links
	0 - Two-way links
Functional Class / Facility Type	1- Interstate
	2- Freeway or Expressway
	3 - Other Principal Arterial
	4 - Minor Arterial
	5- Major Collector
	6- Minor Collector
	7- Local Road or Street
	8 – Ramp (All Ramps)
Total Lanes	Numeric Integer Value
AB_LANES	Lanes in A to B Direction – numeric integer value
BA_LANES	Lanes in B to A Direction – numeric integer value
Speed*	Posted Speed Limit
Area Type	Urban
	Not Urban
Median Type	Divided
	Undivided
	TWLTL

The road attributes for the in-state portion of the network were developed using a combination of data sources for the rural, CMAP, and MPO regions. Directionality in the

network was determined from the HERE network data and supplemented with Google Earth images where necessary.

The functional classification, total number of lanes, speed, area type and median type attributes for the rural areas was developed using a combination of HERE network and ARNOLD network data which were supplement by Freight Analysis Framework version 4 (FAF4) network data.

The number of lanes by direction (AB_LANES/BA_LANES) for the rural areas were determined from the HERE network and verified by Google Earth imagery in cases of roadways with odd total number of lanes. There were instances where the median type was updated to Two Way Left Turn Lanes (TWLTL) based on Google Earth image reviews.

The attributes including directionality, functional classification, total number of lanes, and speed, for the CMAP region of the ILSTDM network were obtained directly from the 2015 CMAP model network and supplemented by ARNOLD data, HERE network data, FAF4 network data and Google Earth images where necessary. The area type, median type and the directional number of lanes attributes for the CMAP region were determined from the same data sources used for these attributes in the rural area. Attributes for the remaining MPO areas in the state are described in Section 2.1.5 Adoption of Regional Models.

All attributes developed for the rural areas and CMAP regions of the in-state network were reviewed and checked using thematic mapping against source data sets. Linkages were established between the ILSTDM network links in the in-state area and the ARNOLD network. Maps illustrating developed functional classification, total number of lanes and median type attributes are shown in **Figures 2-2 to 2-4**.

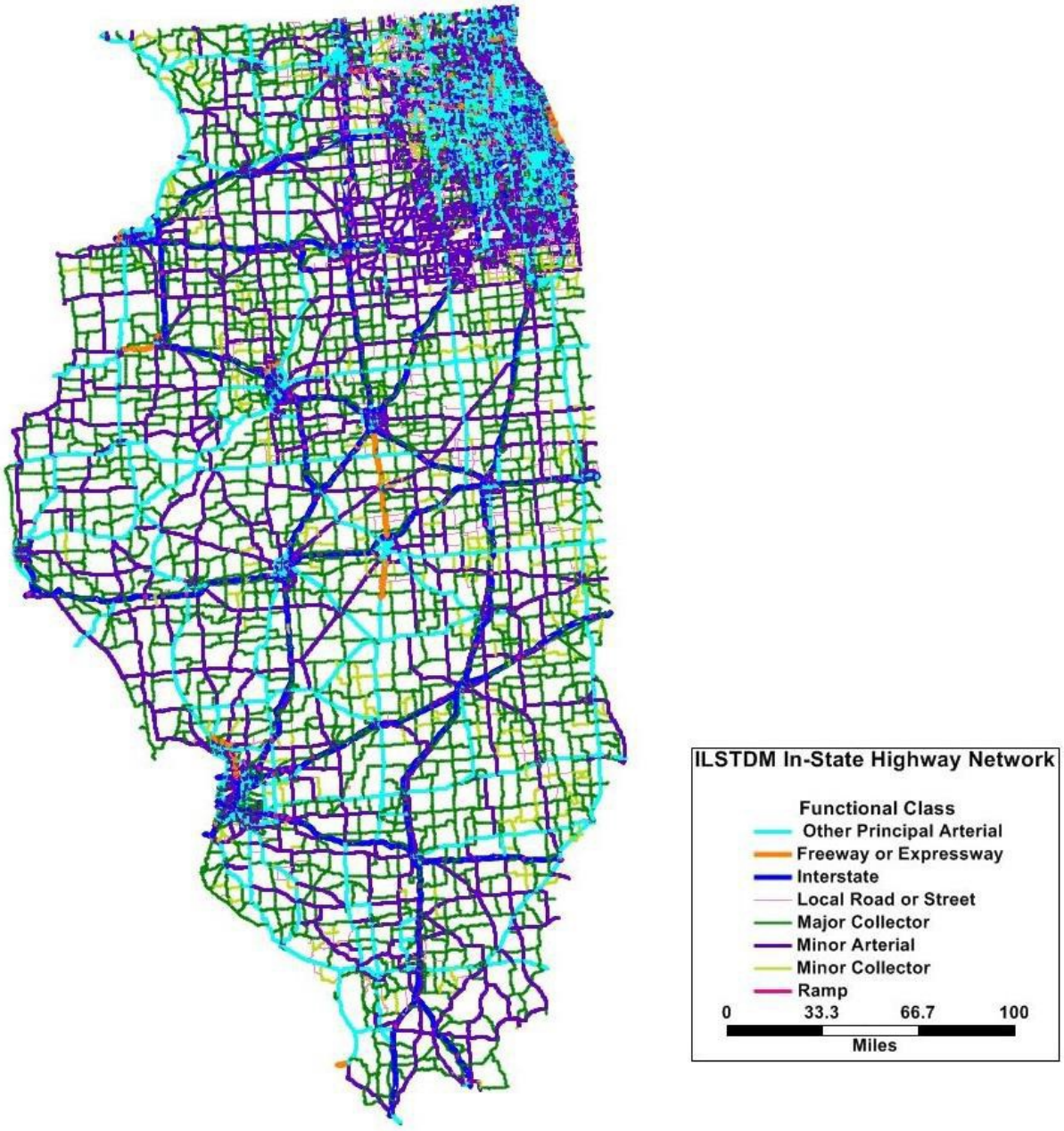


Figure 2-2: ILSTDM Highway Network Functional Classification (In-State)

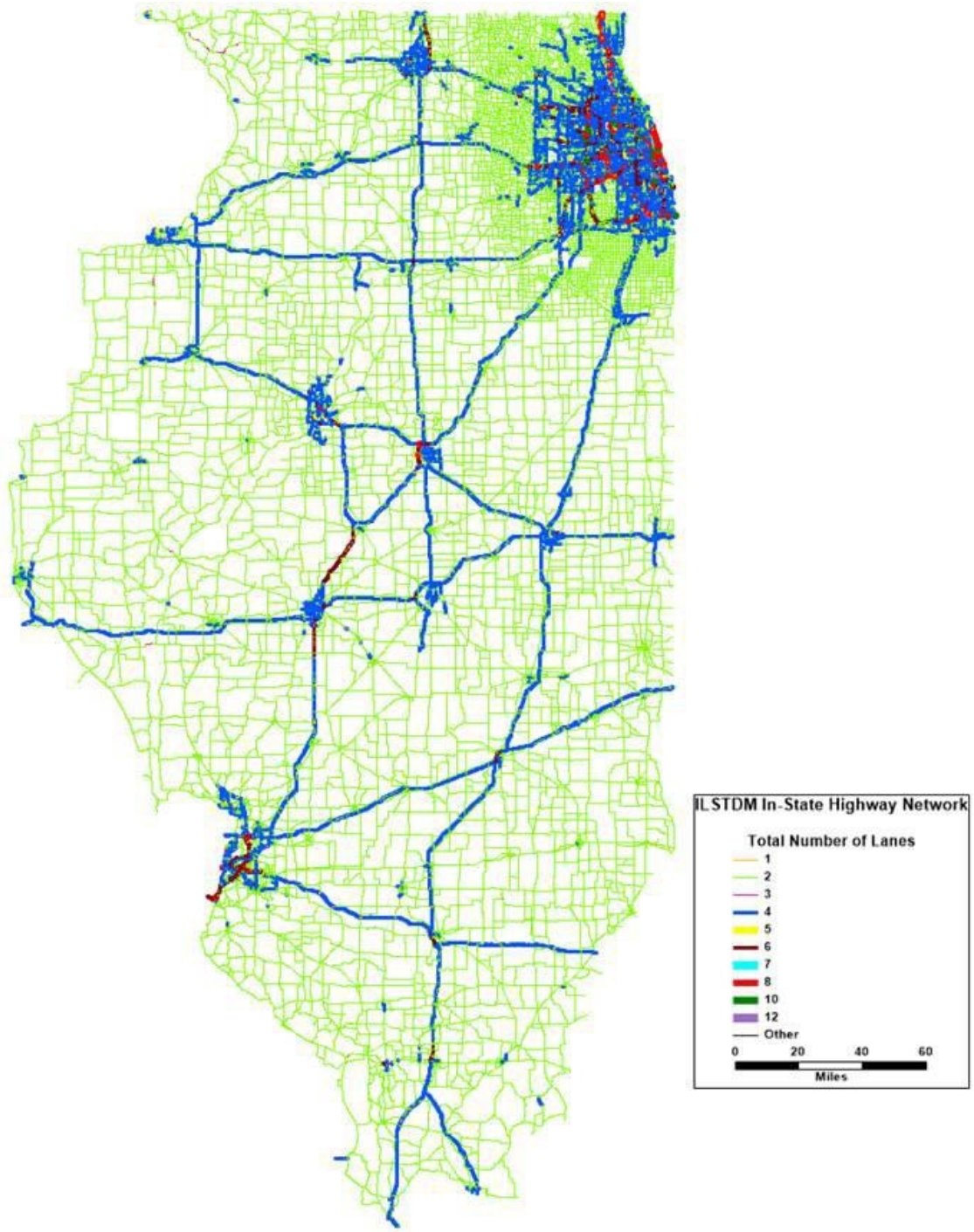


Figure 2-3: ILSTDM Highway Network Total Number of Lanes (In-State)

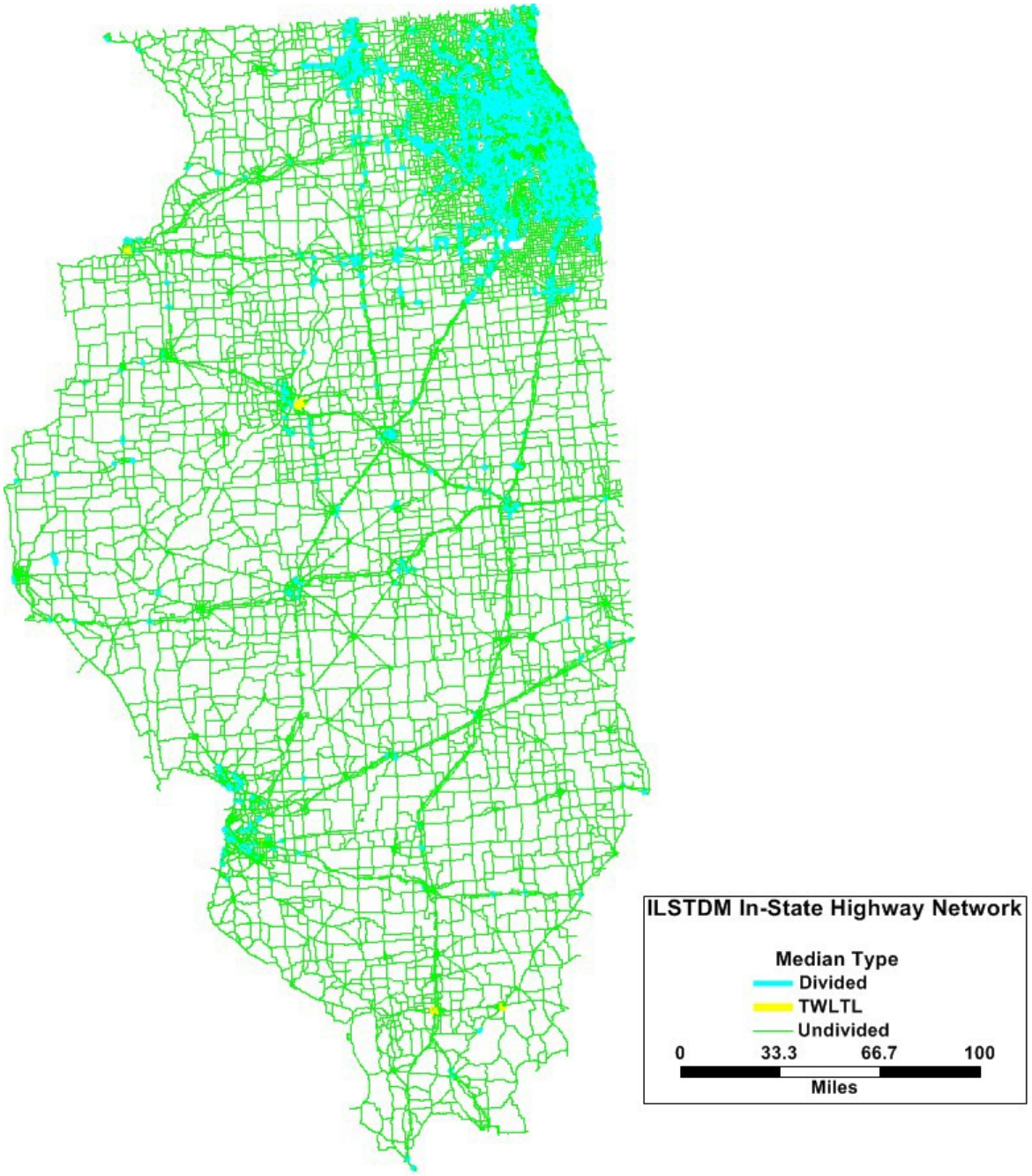


Figure 2-4: ILSTDM Highway Network Median Type (In-State)

2.1.4 Traffic Counts

This section discusses the data sources, methodology and results of the traffic count data in the ILSTDM network for the in-state and halo areas. This section also covers the quality reviews and checks to ensure the accuracy and validity of the traffic counts.

2.1.4.1 Data Sources

Traffic counts from two data sources were identified to be used in the development the in-state network AADT data: 1) the 2017 IDOT Highway shapefile, and 2) the MS2 Statewide AADT shapefile. **Table 2-3** provides an overall summary of the comparison between these two data sources.

Table 2-3: Overall Summary of Traffic Count Comparison Between IDOT and MS2

Comparison Measure	IDOT	MS2
Overall Coverage (1)	50%	34%
Data Year	2008 – 2017	2008 – 2018
Classification Count	HCV (2) (Single and Multi-Unit)	HCV (2) (Single and Multi-Unit)
Station ID	Use "INVENTORY" IDs; "INVENTORY" IDs are not unique.	Use "INVENTORY" IDs; "INVENTORY" IDs are not unique; Less duplicate IDs than IDOT.

(1) Percentage of links in the network that have actual traffic count data.
(2) Heavy Commercial Vehicle (HCV) counts

Table 2-3 indicates that the two data sources have similar coverages, data year, and classification counts. In addition, both data sources have an issue with duplicate station identification numbers (IDs), with the MS2 having less duplicate station IDs than the IDOT data source. To further analyze the differences between the two data sources, traffic count coverage was broken down by functional class of the roadway network and is presented in **Table 2-4**.

Table 2-4: Traffic Count Coverage by Functional Class in IDOT and MS2

Attribute	IDOT			MS2		
Functional Classes	Links	Links with AADT (3)	Coverage	Links	Links with AADT (1)	Coverage
Interstate	13,301	11,014	83%	4,478	3,112	69%
Freeway and Expressway	1,448	1,190	82%	387	248	64%
Other Principal Arterial	44,777	39,910	89%	6,233	5,309	85%
Minor Arterial	54,414	34,730	64%	10,853	6,636	61%
Major Collector	58,267	19,948	34%	20,127	6,153	31%
Minor Collector	15,795	2,017	13%	7,692	844	11%
Local Road or Street	375,161	3,956	1%	253,945	2,849	1%
TOTAL	563,163	112,765	20%	303,715	25,151	8%
Minor Arterial or higher	113,940	86,844	76%	21,951	15,305	70%

(1) This includes only AADT over 1,000 and collected in 2016 or later, which is considered significant and relevant for model validation purpose.

As **Table 2-4** shows, both IDOT and MS2 have good coverage for each functional class, especially for Minor Arterial functional classes and higher, which was considered most significant to model validation. Please note this table only includes AADT over 1,000 vpd, collected in 2016 or later, because other AADT data would not be considered significant and relevant for model validation purpose.

2.4.1.2 Traffic Count Development Methodology

The methodology used in the development of traffic counts is described in the subsequent steps.

Step #1 – Establish the Station ID System

The "INVENTORY" IDs in the MS2 data were not unique and could not be readily used as the Station ID system for the traffic count data in the ILSTDM network. A new Station ID system had to be established before using the MS2 data for the development of AADT counts within the network. After examining the available ID options in MS2 data, a methodology was established to create the new Station ID which involved the concatenation of a 3-digit county Federal Information Processing Standards (FIPS) code, the INVENTORY ID of the MS2 data and the MS2 link ID, as shown below:

County Code (FIPS) – Original MS2 "INVENTORY" ID – Original MS2 Link ID

060 – 20310-404840 – 194050

This new Station ID system ensures that each Station ID is unique and has the added benefit of containing information about the counties where the counts are located.

Step #2 – Import the traffic count data into ILSTDM network

After the new Station ID is established, the next step is to import the traffic count data with the new Station IDs from MS2 shapefile into the ILSTDM network. Since the MS2 data does not contain functional classification for each link, the first step is to obtain the corresponding functional classifications from the IDOT Highway Shapefile.

After the functional classifications are added to the MS2 data, the next step is to import the traffic count data from MS2 into ILSTDM network. The count data was imported by functional class i.e. each functional class in MS2 was imported separately to the corresponding functional class in ILSTDM network. The overall principle is to tag each ILSTDM link with a MS2 link from the corresponding functional class in the same or closest location.

Step #3 – Review the result model network and improve data quality

After importing all the traffic counts from MS2 to ILSTDM network, the next step is to review the resulting model network and perform quality checks, to ensure the quality and validity of the traffic data in ILSTDM network. Two types of quality checks were conducted:

1. Check for links with duplicate or incorrect traffic count record.

   Due to the nature of tagging, there could be links with duplicate traffic count record resulting from the import process. For regular two-way direction links, each traffic count record should only be tagged once; for dualized one-way links, each traffic count record should only be tagged twice. All links with duplicate records were identified and the duplicate records were removed. There were a few cases in which, some links were tagged by incorrect record, due to their proximity. Such links were also identified and corrected.

2. Check for links with abnormal traffic count volumes

   A quantitative check was performed for each functional class to identify abnormal values in traffic counts. For example, interstate links with less than 1,000 AADT were possibly incorrectly tagged. Those links were identified and corrected for each functional class.

Results

Table 2-6 below summarizes the result of traffic count data in ILSTDM network, compared with the original MS2 database.

Table 2-6: Result Summary of Traffic Count Data in MS2 and ILSTDM

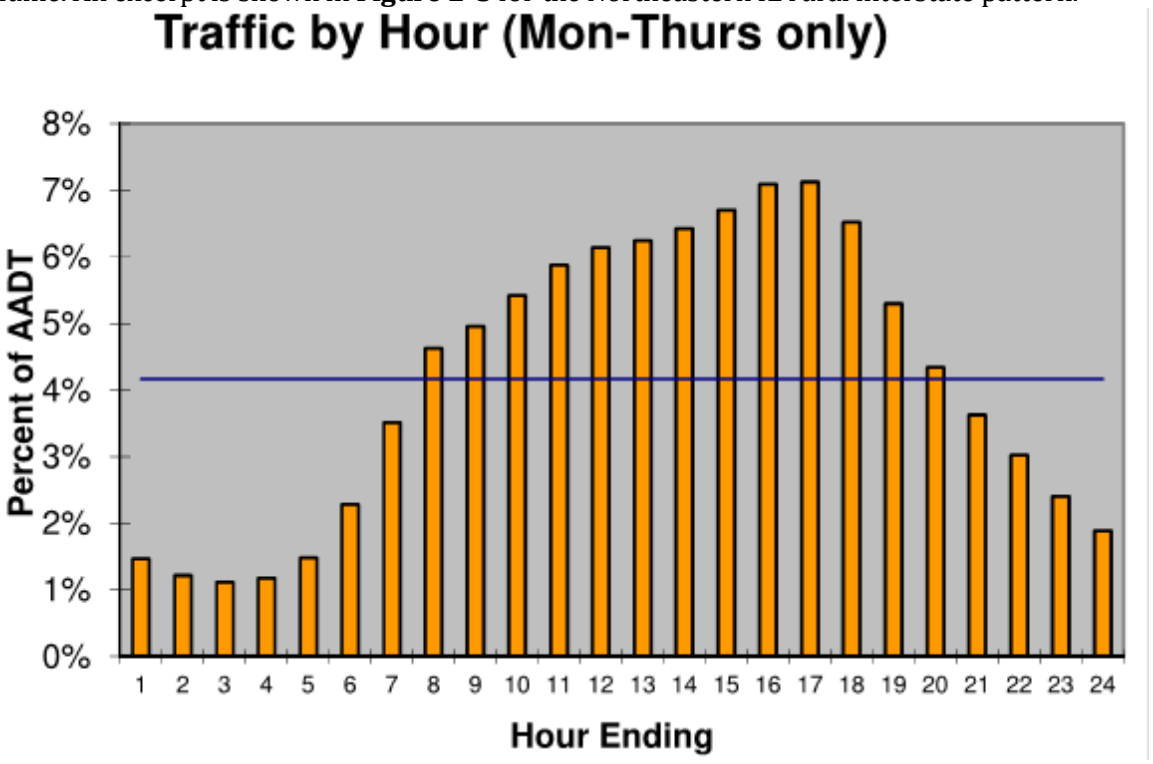
Attribute	Original MS2	ILSTDM
Functional Classes	Links with AADT (1)	Links with AADT (1)
Interstate	3,112	1,418
Freeway and Expressway	248	195
Other Principal Arterial	5,309	5,415
Minor Arterial	6,636	5,597
Major Collector	6,153	4,090
Minor Collector (2)	844	260
Ramps	Included in other classes	2,061
TOTAL	22,302	19,036

(1) This includes only AADT over 1,000 and collected in 2016 or later.
(2) "Local Road or Street" functional class was not considered significant for model validation purpose, thus not imported to ILSTDM network.

The summary confirms that the resulted ILSTDM network has obtained desirable traffic count from MS2 data, with each functional class aligned accordingly.

2.4.1.3 Hourly Traffic Counts

In addition to AADT data, hourly traffic count data is also needed to validate model output by time periods. The *2017 Illinois Travel Statistics* report was identified as the source for hourly traffic count data inside IL. The traffic patterns section in the report contains the hourly traffic patterns by region (Northeastern and Downstate), area type (Urban and Rural), and functional class (Interstate and Non-Interstate). The eight different hourly traffic patterns in the report were presented in a bar graphs, showing the percentage of daily total traffic volume. An excerpt is shown in **Figure 2-5** for the Northeastern IL rural interstate pattern.



Source: 2017 Illinois Travel Statistics report
Figure 2-5: Hourly Traffic Variation – Northeastern Illinois Interstate (Rural) Traffic Patterns

These percentages were used to convert AADT to hourly volume, and the hourly volumes were grouped into four time periods – AM Peak (7am-10am), PM Peak (4pm-7pm), Mid-Day (10am-4pm) and Night (4pm-7am).

2.1.5 Adoption of Regional Models

This section discusses how regional model data is incorporated into the highway network of ILSTDM. Existing highway networks from all the functional MPO travel models were evaluated to collect accurate information on attributes for the ILSTDM highway network. The list of attributes included in the MPO region of the ILSTDM network is consistent with that in the rural and CMAP area.

The initial ILSTDM highway network was adopted from the HERE network and appropriate attributes were later updated through careful evaluation of the existing MPO highway networks. In most cases, discrepancies in attributes were limited to roadway functional classification, speed, and median type. Some of the MPOs however had updated information on these attributes. These MPOs include:

- East-West Gateway Council of Government
- Bi-State Regional Planning Commission
- Champaign County Regional Planning Commission
- Dubuque Metropolitan Area Transportation Study

Figure 2-6 shows updated roadway functional class information for the highway network in the Champaign County travel model.

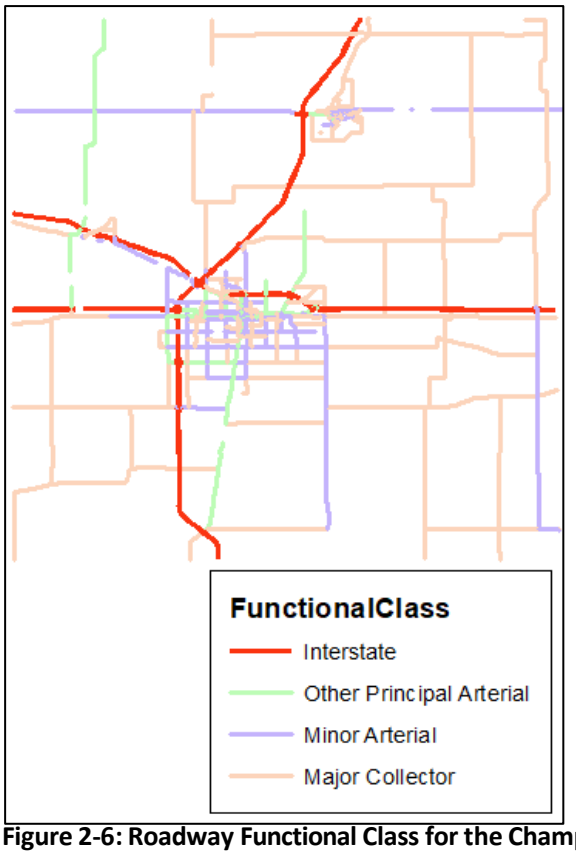


Figure 2-6: Roadway Functional Class for the Champaign County Highway Network

The HERE network link speed attributes were compared with the MPO highway network speed limit information. **Figure 2-7** shows speed limit information for major highway links in the East-West Gateway MPO highway network. The HERE network had incomplete information on median types and the majority of the MPO highway networks also did not have information on median types. However, some MPO highway networks including the Bi-State MPO, and the Champaign County MPO had updated information on locations of Two-Way Left Turn Lanes (TWLTL) within the highway network for these regions. **Figure 2-8** shows TWLTL locations in the Bi-State MPO highway network.

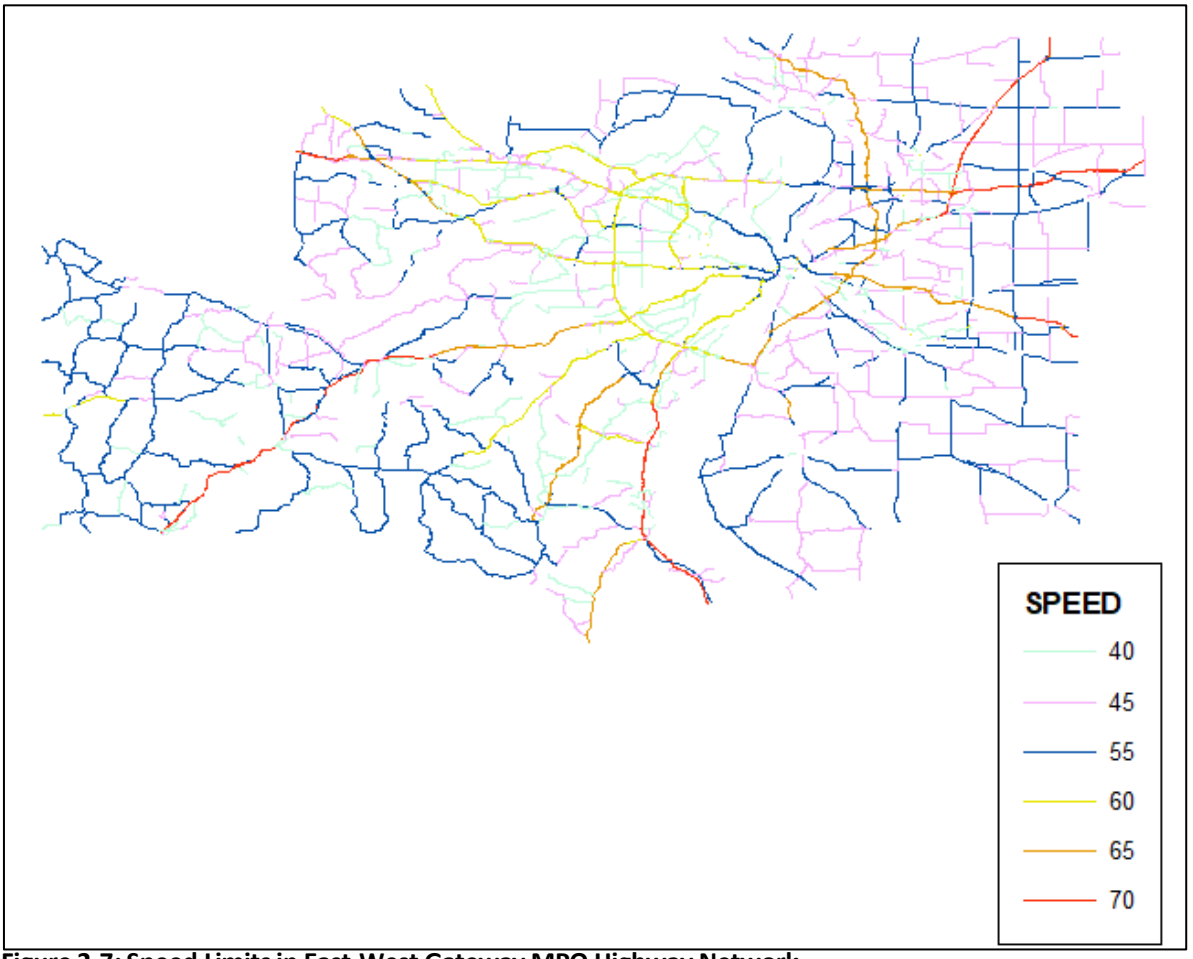


Figure 2-7: Speed Limits in East-West Gateway MPO Highway Network

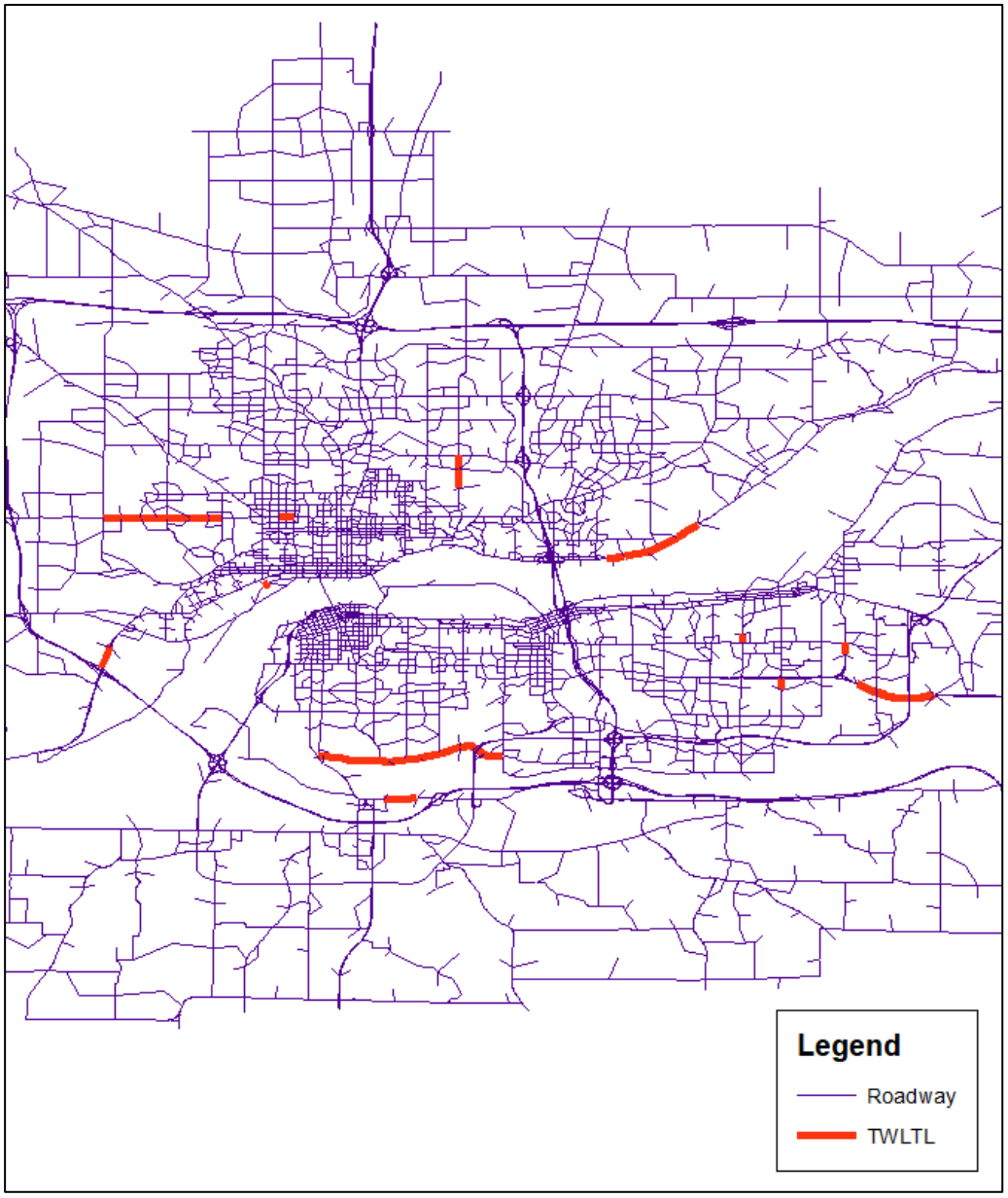


Figure 2-8: TWLTL Locations in the Bi-State MPO Highway Network

All the relevant updated attribute information from the available MPO highway networks were transferred to the ILSTDM highway network for the MPO regions.

2.2 Outside Illinois

The ILSTDM highway network was extended outside Illinois state border. The network outside the state border was categorized as halo and national. The halo area was extended approximately 50 miles from Illinois state border to provide more route choice options to the out of state traffic. The national network is extended beyond the halo area which includes mostly interstates of the rest of the country. The national level network will facilitate the long-distance travel pattern across Illinois.

2.2.1 Geography

The geography of the halo area network includes major roads within a 50-mile buffer around Illinois. It includes the roadways of bordering states: Wisconsin, Iowa, Missouri, Kentucky and

Indiana. The ILLDM was used as a guidance in the roadway selection process of halo area. All the roadway links of the CMAP model that overlapped with the halo area were included in the halo area network. The halo area also includes links of other regional models: East Central Intergovernmental Association, State Line Area Transportation Study, Bi-State Regional Commission and East-West Gateway Council of Government. **Figure 2-9** shows the halo area highway network highlighting the links from CMAP, and other regional models. The source of halo area network links is HERE network.

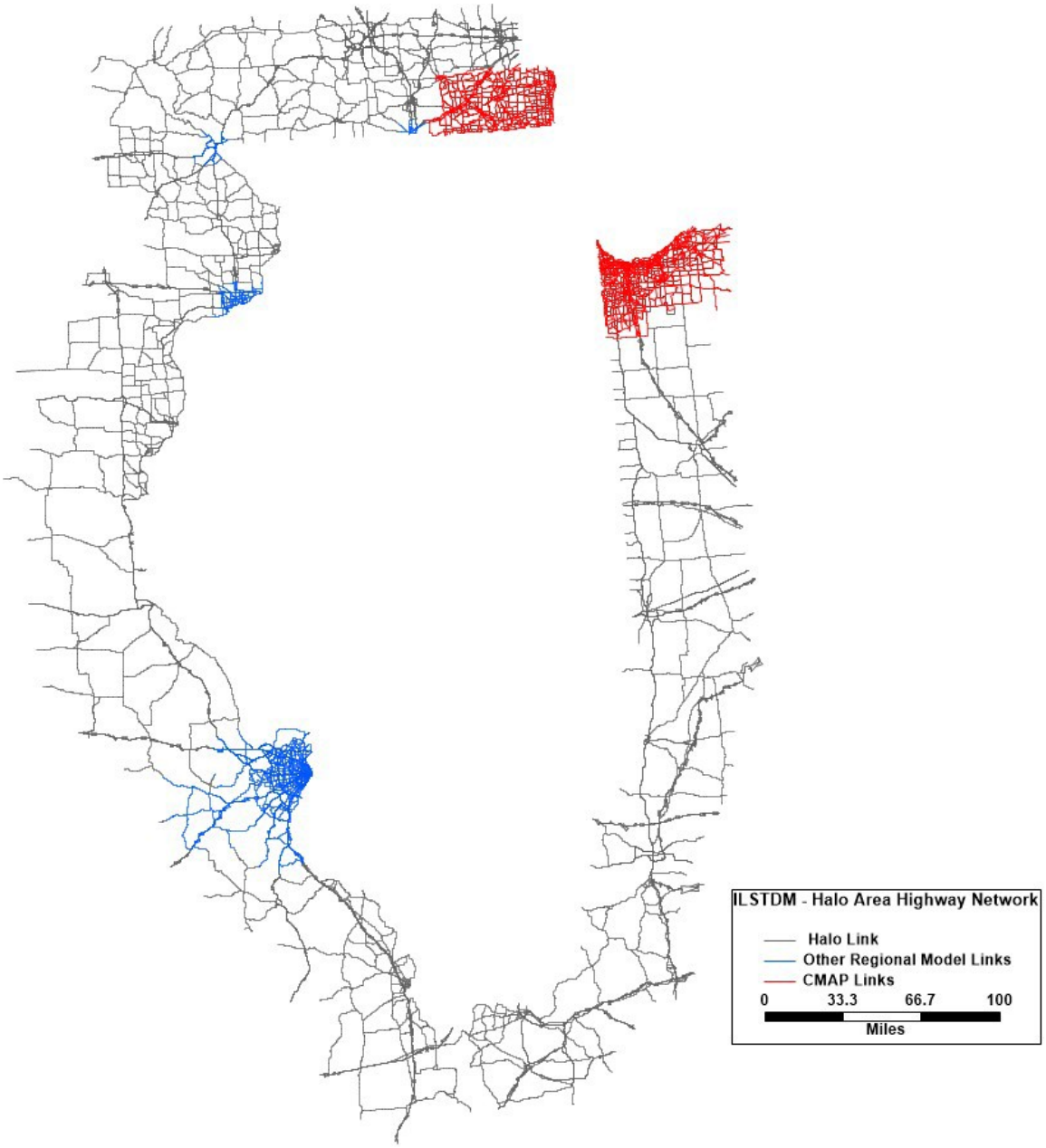


Figure 2-9: Halo Area Network

The national level network includes mostly the interstate highways found in the rest of the United States; which are outside halo region, and the state of IL. Some other major highways were added in addition to interstates in the adjacent states. The source of national network is the FAF4 network. **Figure 2-10** shows the national highway network of the ILSTDM.

Figure 2-10: National Highway Network

2.2.2 Centroid Connectors

Centroid connectors were added to the roadway links of the halo and national areas. Although freeways, ramps, and one-way links were excluded from the automated centroid connector creation process, there were exceptional zones in the halo area, where only freeways were available as road network in the zone; in such cases, the centroid connectors were manually added to one direction of the freeway, and a small two-way connector link was also added to bridge the connection of the centroid connector from one direction to the other direction of the freeway to the other as shown in **Figure 2-11**.

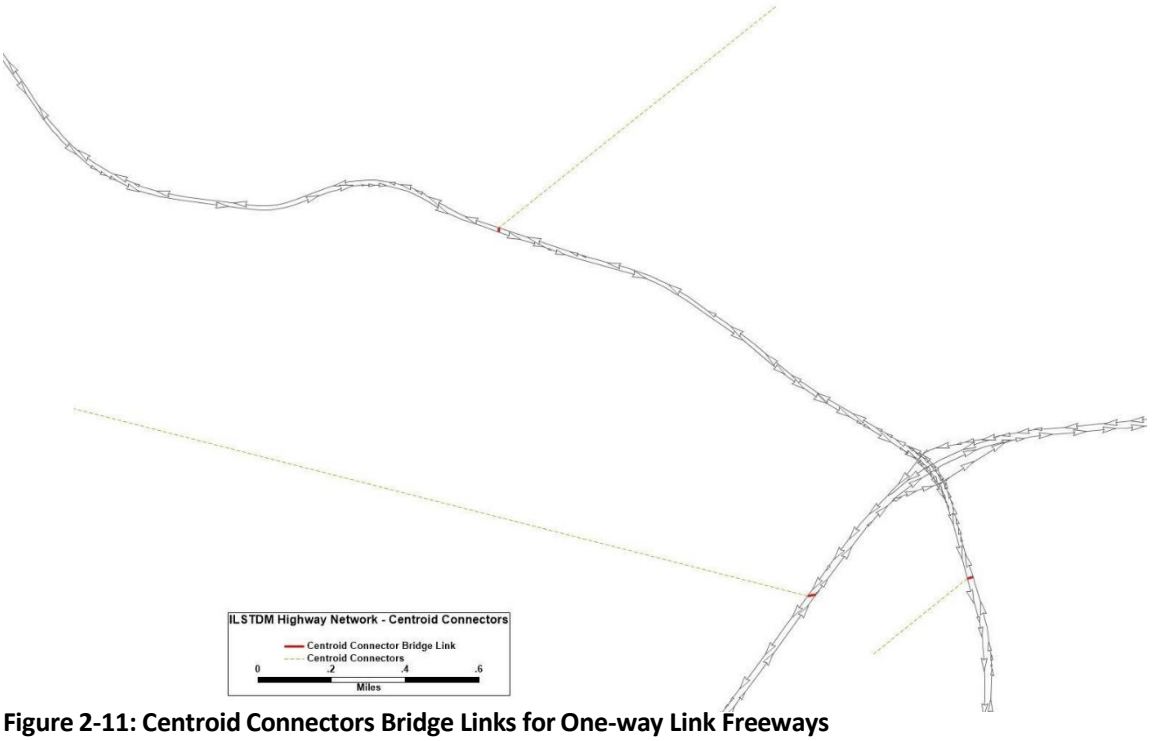


Figure 2-11: Centroid Connectors Bridge Links for One-way Link Freeways

Figure 2-12 and **Figure 2-13** show examples of the halo area and national area network centroid connectors, respectively.

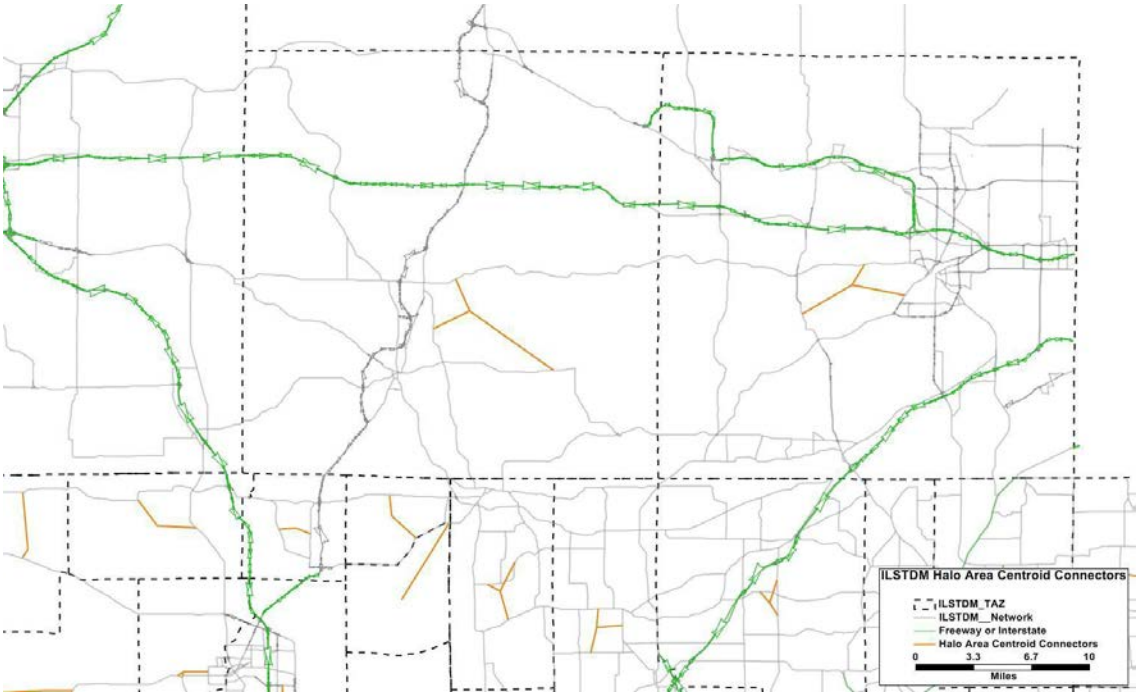


Figure 2-12: Halo Area Centroid Connectors

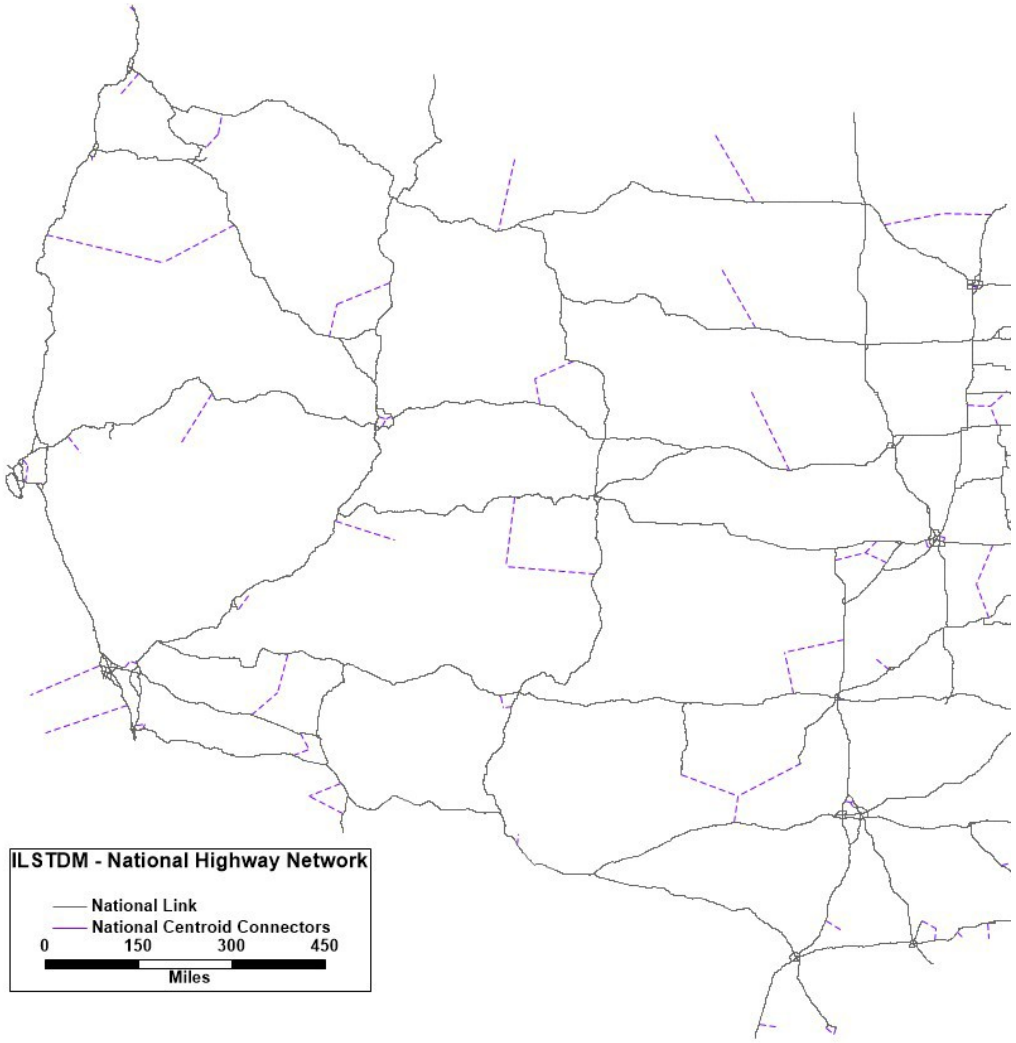


Figure 2-13: National Area Centroid Connectors

Once the centroid connectors for the halo area and national areas were added to the network, the roadway attributes listed in **Table 2-7** were coded in for those centroid connectors.

Table 2-7: Attributes for Out of State Centroid Connector Links

Variable	Description
ST_NAME	Centroid Connector
FCLASS	99
FCLASS_DESCRIPTION	External Centroid Connector
TOTALLANES	20
AB_LANES	10
BA_LANES	10
SPEEDLIMIT	35 - 55 mph
MEDIAN_TYPE	Undivided

The resulting highway network for the ILSTDM which contains the national, halo and in-state links and their respective centroid connectors is shown in **Figure 2-14**.

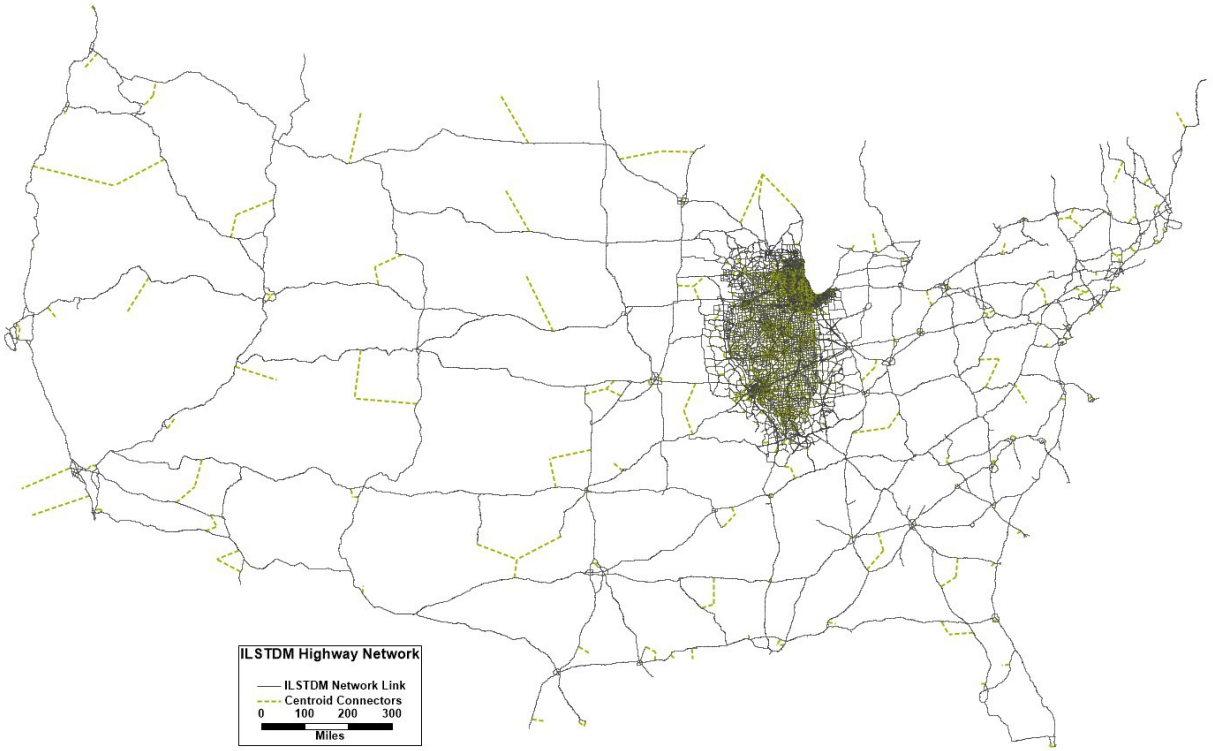


Figure 2-14: ILSTDM Highway Network

2.2.3 Out of State Roadway Attributes

Highway network attributes were coded in the halo and national areas. The list of attributes in these areas were coded to be consistent with the in-state part of the network. **Table 2-8** lists the attributes and data sources used to populate attributes in the halo and national portions of the ILSTDM highway network.

Table 2-8: Network Attributes Outside Illinois

Attribute	Values / Description	Data Source
Directionality	1 or -1 for One-way links	CMAP, HERE and FAF4
	0 - Two-way links	
Functional Class / Facility Type	1- Interstate	CMAP, HERE and FAF4
	2- Freeway or Expressway	
	3 - Other Principal Arterial	
	4 - Minor Arterial	
	5- Major Collector	
	6- Minor Collector	
	7- Local Road or Street	
	8 – Ramp (All Ramps)	
Total Lanes	Numeric Integer Value	CMAP, HERE and FAF4
AB_LANES	Lanes in A to B Direction – numeric integer value	CMAP, HERE and FAF4
BA_LANES	Lanes in B to A Direction – numeric integer value	CMAP, HERE and FAF4

Attribute	Values / Description	Data Source
Speed*	Posted Speed Limit	CMAP, HERE and FAF4
Area Type	Urban	Census Urban Area Boundary
	Not Urban	
Median Type	Divided	CMAP, HERE and FAF4
	Undivided	
	TWLTL	

2.2.4 Traffic Counts

2.2.5 Adoption of Regional Models

The HERE highway network was also utilized for the MPO highway network coverage in the halo area. The major attributes described in **Table 2-2** were updated from the existing MPO highway networks, where applicable. The development of highway network attributes for the MPO areas outside of IL in the halo area was developed following a similar approach as described in Section 2.1.5 of the report.

2-20

Section 3

TAZ and Socioeconomic Data Development

This section discusses the data source, methodology and results of the development of TAZ geography and socioeconomic data for the ILSTDM including quality reviews and checks. As with the network development, the areas of the ILSTDM geographic structure include in-state, halo, and national areas.

3.1 1 Inside Illinois

3.1.1 Geography

This section discusses the methodology, quality checks and reviews, and results used in the development of the TAZ geographic boundary within the state of IL.

Three areas are defined in the ILSTDM TAZ structure for within IL

- CMAP: urban areas within the CMAP boundary
- MPO: urban areas within MPO boundaries, other than CMAP
- Rural: all other areas outside of CMAP and other MPO areas

An overview map of the TAZs in all three areas is shown below in **Figure 3-1**.

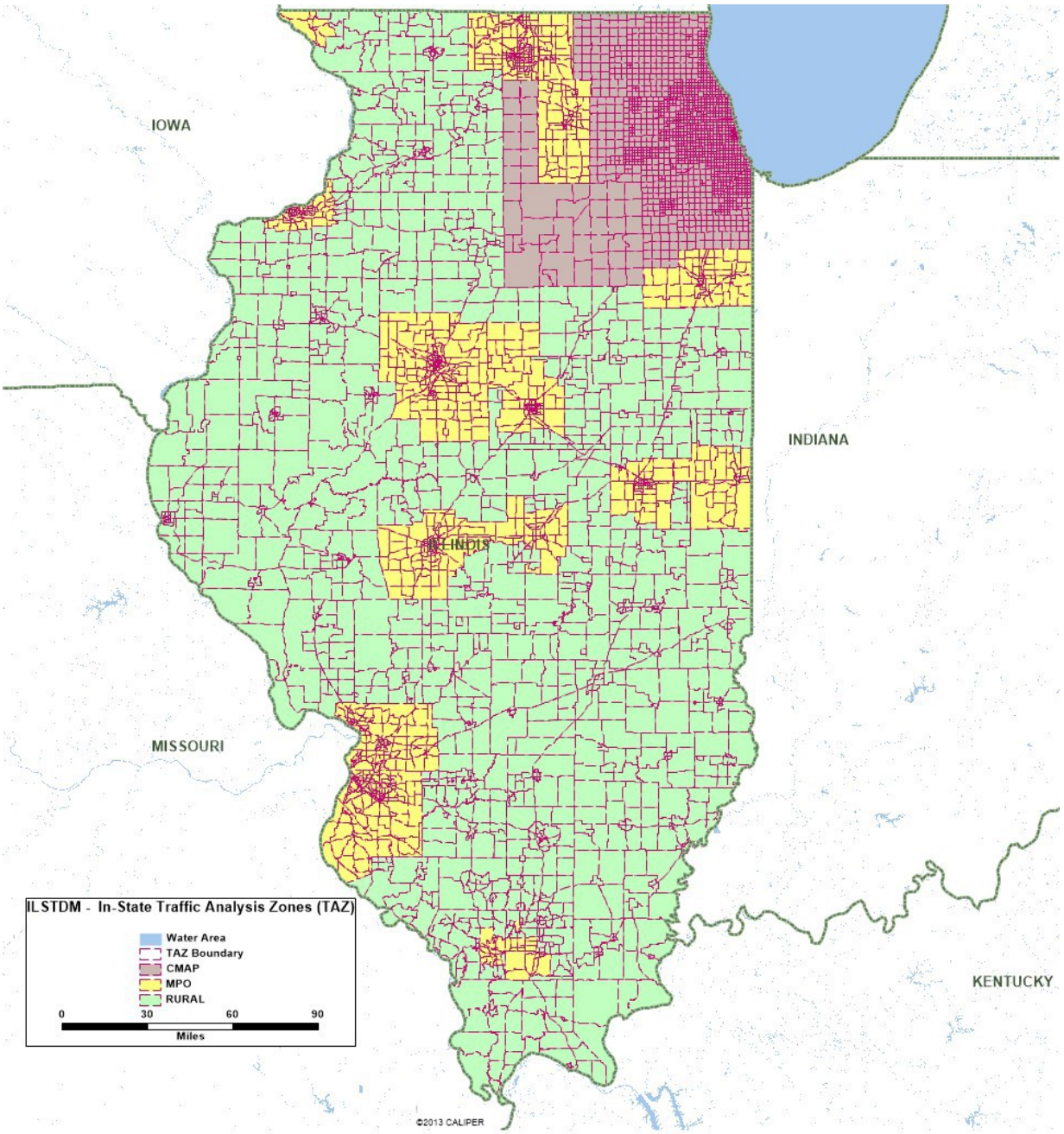


Figure 3-1: ILSTDM TAZ Boundaries by Area

3.1.1.1 Data Sources

The data sources used to establish the ILSTDM TAZ boundaries are:

- Illinois Long Distance Passenger and Freight Truck Travel Modeling (ILLDM) TAZ boundaries
- Regional model (MPO) TAZs, including the 2009 CMAP zones
- Adjacent state model zones
- National model zones
- US Census boundaries (Blocks, Block Groups and Tracts)
- Fright Analysis Framework 4 (FAF4) zones

Additionally, supplementary sources to assist with the review and modification of zone boundaries include web-based aerial imagery and GIS files (highways, railroads, water bodies, military bases, and airports). These sources aided in the zone boundary editing process.

3.1.1.2 Methodology

The methodology to develop the ILSTDM TAZ system starts from the ILLDM zone system and adds more detail in the rural areas and less detail in the urban areas, while maintaining a direct linkage to the MPO zones where model boundaries overlap.

CMAP Area

The CMAP zones in the ILSTDM were developed from 2009 CMAP model TAZ geographic layer, which had a total of 1,944 zones. Due to the high density of the population, and to make a more efficient framework for data processing and transferability in the future, it was determined to maintain the original CMAP TAZs rather than to aggregate further. In addition, some of the CMAP TAZs were re-assigned to MPO areas, where the TAZ boundaries were adjusted. These zones are flagged in the geographic file. The CMAP zones in the ILSTDM can be identified by selecting where the Source attribute ("SRC") is equal to "CMAP", which yields 1,752 zones.

MPO Area

TAZ boundaries for the ILSTDM for the fourteen urbanized areas in Illinois (outside the CMAP boundaries) were developed by detailed evaluation of existing MPO travel demand model TAZ boundaries (if available) and US Census block boundaries with in the urbanized areas. **Table 3-1** shows TAZ input sources and final total TAZs for the IL urbanized areas outside of the CMAP urbanized area.

Eight MPOs currently have existing TAZs for their regional travel models. These TAZ boundaries were reviewed for the ILSTDM and aggregated based on existing population, presence of natural and man-made barriers, political, and planning boundaries. Any existing MPO TAZ with less than 1,000 population was considered for aggregation. For the ILSTDM TAZ aggregation, only the existing MPO TAZs within IL boundaries were considered for aggregation. The rest of the MPO TAZs outside IL boundaries are part of the halo area in the ILSTDM.

Table 3-1: TAZ Boundary Input Source for the Illinois MPOs

Urbanized Area/MPO	TAZ Boundary Input Source	Total TAZs
Bi-State Regional Commission (BSRC)	MPO Travel Model	69
Champaign County Regional Planning Commission (CCRPC)	MPO Travel Model	70
Danville Area Transportation Study (DATS)	US Census Block Boundaries	45
Decatur Urbanized Area Transportation Study (DUATS)	US Census Block Boundaries	40
DeKalb-Sycamore Area Transportation Study (DSATS)	MPO Travel Model	75
Dubuque Metropolitan Area Transportation Study (DMATS)	MPO Travel Model	7
East-West Gateway Council of Governments (EWGCOG)	MPO Travel Model	261
Kankakee Area Transportation Study (KATS)	US Census Block Boundaries	78
McLean County Regional Planning Commission (MCRPC)	US Census Block Boundaries	70
Rockford Metropolitan Agency for Planning (RMAP)	MPO Travel Model	189
Southern Illinois Metropolitan Planning Organization (SIMPO)	US Census Block Boundaries	39
Springfield Area Transportation Study (SATS)	MPO Travel Model	100
Tri-County Regional Planning Commission (TCRPC)	MPO Travel Model	214
Total		1,257

Four MPO boundaries extend beyond Illinois. These four MPO boundaries include:

- Bi-State Regional Planning Commission
- Dubuque Metropolitan Area Transportation Study
- East-West Gateway Council of Government
- Stateline Area Transportation Study

Five MPOs currently do not have TAZ boundaries defined for their regional travel models. For these regions, US Census block boundaries within the urbanized areas were used to develop the ILSTDM TAZ boundaries. The US Census blocks were aggregated to fulfill the minimum 1,000 population for each urbanized area TAZ in the ILSTDM. Due consideration was given to natural and man-made barriers, political and planning boundaries while completing aggregation process. Thus, some aggregated TAZs have less than the minimum target population of 1,000 per TAZ to avoid irregular shapes and crossing natural and/or man-made barriers.

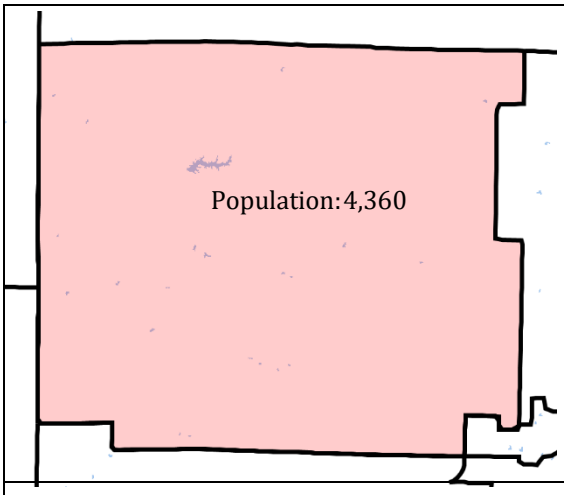
The rural zones in the ILSTDM were developed from ILLDM zone system which had an original 599 zones at the US Census Tract level in the areas designated as rural area. These zones were refined using US Census Block boundaries based on judgment and experience with the following methodology:

- Population thresholds (maximum 3,000),
- Employment thresholds (maximum 5,000),
- Natural barriers (bodies of water),
- Man-made barriers (limited access highway and rail networks),
- Jurisdictional boundaries (county and MPO boundaries),
- Homogenous land uses (existing and future),
- Urban-to-rural transition at MPO/CMAP boundaries,

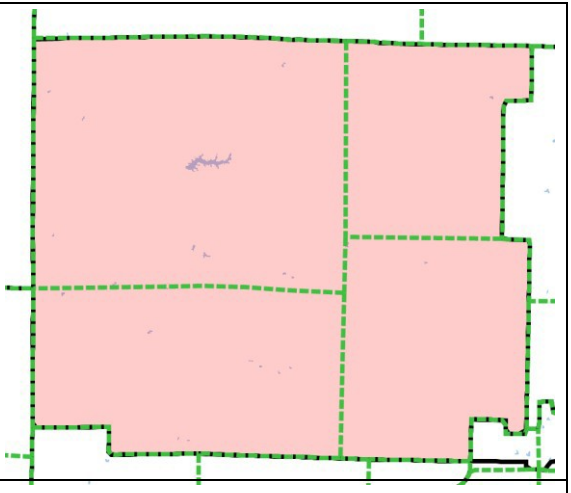
- Compatibility with the base and future year highway and transit network,
- Separate town centers (densely populated areas) from other areas, and
- Irregular shaped zones where split results in better centroid locations and connections.

Examples showing the application of these rules are shown in **Figure 3-2 (a-f)**.

a. Population Over 3,000

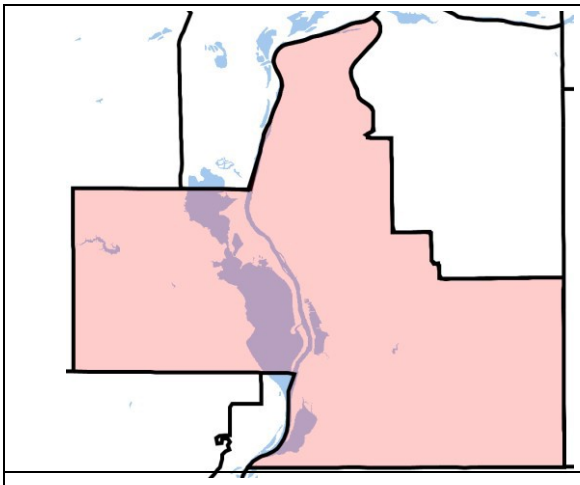


Original TAZ's population is over 3,000.

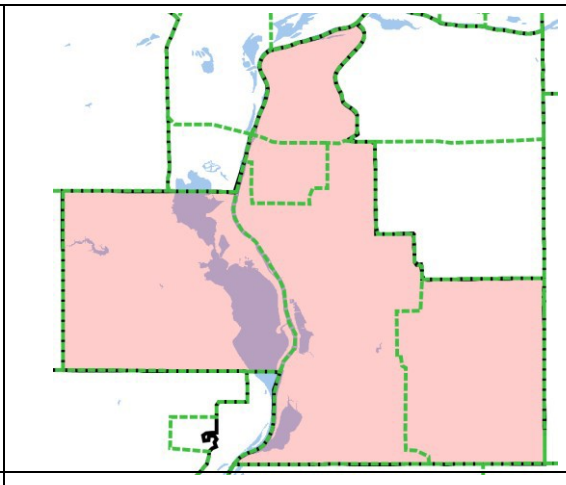


Split into 4 smaller TAZs following Census Block boundaries.

b. Natural Barrier

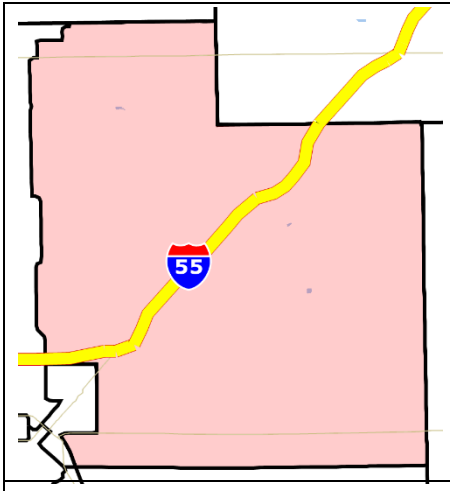
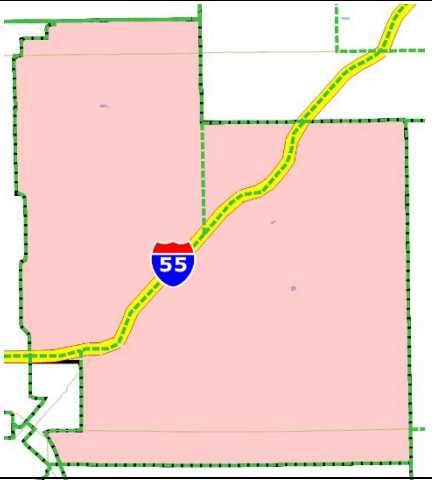


Original TAZ overlaps a large non-traversable water body.

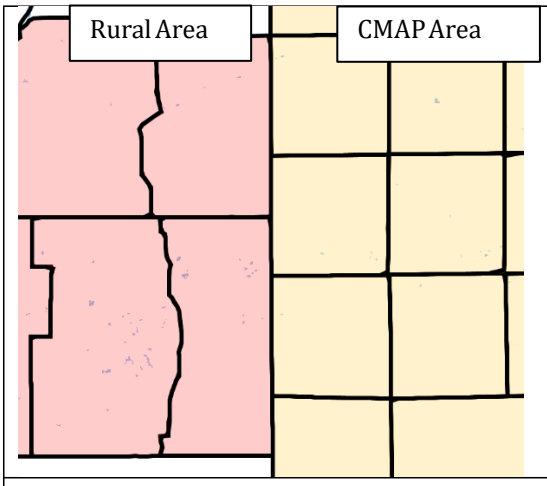
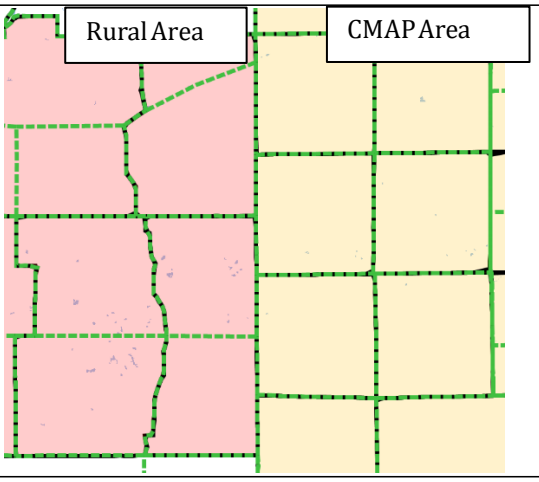


Split along the water body to reflect geography correctly.

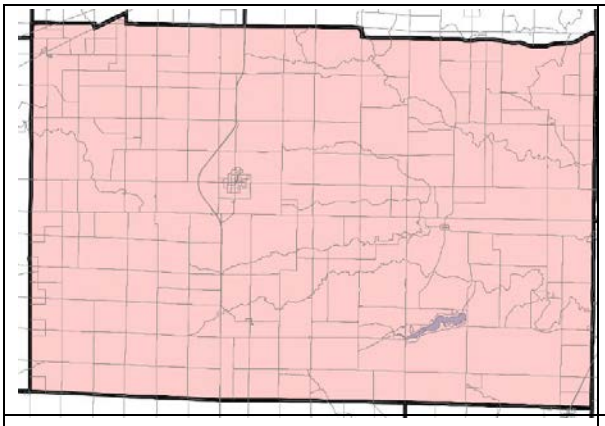
c. Man-Made Barrier

	
Original TAZ overlaps Interstate 55 Freeway	Split along the freeway to reflect connectivity appropriately.

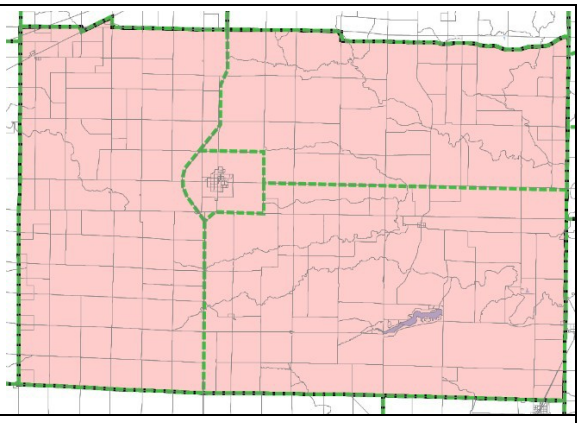
d. Urban to Rural Transition at MPO/CMAP Boundaries

	
The sizes of the original rural TAZs increase immediately outside of the CMAP area.	Split those rural TAZs to make a smoother transition of size between CMAP and rural areas.

e. Separate Town Center (densely populated areas) From Other Areas

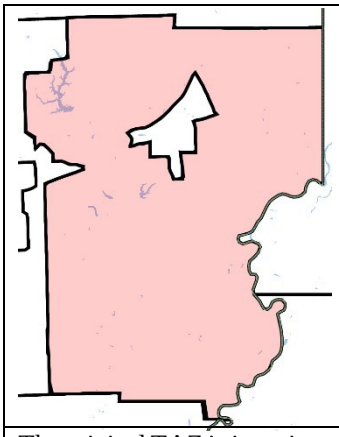


The original TAZ contains a small-town center inside of its boundaries.

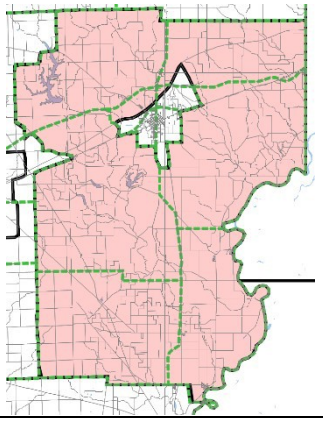


Separate the town center from the surrounding areas and split the rest appropriately.

f. Irregular Shape



The original TAZ is in an irregular shape (donut shape) that affects the connectivity of the TAZ in the center.



Split the TAZ into multiple smaller TAZs and adjust boundaries to improve connectivity.

Figure 3-2 (a-f): Rural Area TAZ Modifications

3.1.1.3 Results

The TAZ statistics for the ILLDM zone system and ILSTDM zone system are presented in **Table 3-2.** The ILSTDM zone system is a result of aggregating the MPO area TAZs to reach an appropriate level of detail, disaggregating TAZs in the rural areas to provide more detail, and maintaining the CMAP area TAZs as the original structure for transferability, for statewide modeling purposes.

Table 3-2: TAZ Statistic Comparison between ILLDM and ILSTDM

Area	Total TAZs		Average TAZ Size (sq. mi)		Average TAZ Population	
	ILLDM	ILSTDM	ILLDM	ILSTDM	ILLDM	ILSTDM
CMAP*	1,944	1,752	5.6	3.4	5,498	4,984
MPO	3,104	1,252	1.6	7.4	543	1,922
Rural	599	1,362	72.6	30.1	3,562	1,260
Total	5,647	4,366	10.5	12.9	2,569	2,944

*Note that some CMAP zones were re-assigned to the MPO area and some CMAP zones are outside of the State boundary.

As shown in **Table 3-2**, the total TAZs in the MPO areas were reduced by aggregation, with increased average TAZ size and average TAZ population as a result. Total TAZs in rural areas were increased by disaggregation, with decreased average TAZ size and average TAZ population as a result. TAZs in the CMAP areas were maintained as its original structure, except for some TAZs re-assigned to MPO area. This result met the expected goal set for this task.

Based on *Validation and Sensitivity Considerations for Statewide Models* (NCHRP Project 836-B Task 91), the typical number of zones in a statewide model range from 3,000 to 6,000 zones, with South Carolina and Florida exceeding 6,000 zones (see **Table 2**). For the ILSTDM, TAZs between 5000 and 6000 zones would be ideal.

3.1.2 Base Year Demographic Data

This section discusses the development of the demographic data for the ILSTDM zones within IL and the review and quality checks performed to verify the data. The demographic data and data sources used in the development of the base year demographic data is listed in **Table 3-3**. County controls totals for population and households were developed using 2017 American Community Survey (ACS) five-year estimates for all counties within IL.

Table 3-3: Demographic Attribute Data Developed for the ILSTDM

Demographic Attribute	Data Source	Table Number
Total Population	2017 ACS Five Year Estimates	B01003
Household Population	2017 ACS Five Year Estimates	B11002
Group Quarter Population	2017 ACS Five Year Estimates	B26001
Total Households	2017 ACS Five Year Estimates	B11011 or B11016
Average Household Size	2017 ACS Five Year Estimates	S1101
Average Household Income	2017 ACS Five Year Estimates	S1901 or S1902 or S1903, or B19013
Average Household Workers	2017 ACS Five Year Estimates	B08202
Average Household Vehicles	2017 ACS Five Year Estimates	B08201
Average Household Students	2017 ACS Five Year Estimates	No ACS Table available for this attribute
Percent of Household Seniors	2017 ACS Five Year Estimates	S1101
Average Parking Cost per Hour (cents)	2017 ACS Five Year Estimates	No ACS Table available for this attribute
K-12th Grade School Enrollment (at school location)	2017 ACS Five Year Estimates	S1401
College/University Enrollment (at university location)	2017 ACS Five Year Estimates	S1401

The development of the base year in-state demographic data utilized 2017 ACS five-year estimate data for all attributes by disaggregating county level data to the TAZ. In the rural zones, the process begins by assigning the 2010 census blocks to rural TAZs in the ILSTDM and then calculating disaggregation factors as the ratio of block level households and population to their respective county control totals. The developed disaggregation factors were used to allocate the county level data to each block within a TAZ. The block data is then aggregated for all TAZs in the rural areas of the ILSTDM.

The developed TAZ level demographic data was reviewed and checked for reasonableness, sometimes using google images to check for areas with high concentration of households or population to make sure this was accurate after thematic mapping. The maps for total population and total households are shown in **Figure 3-3** and **Figure 3-4**.

All in-state demographic data for CMAP, MPO, and rural areas, once disaggregated were scaled back to the 2017 ACS county level control totals.

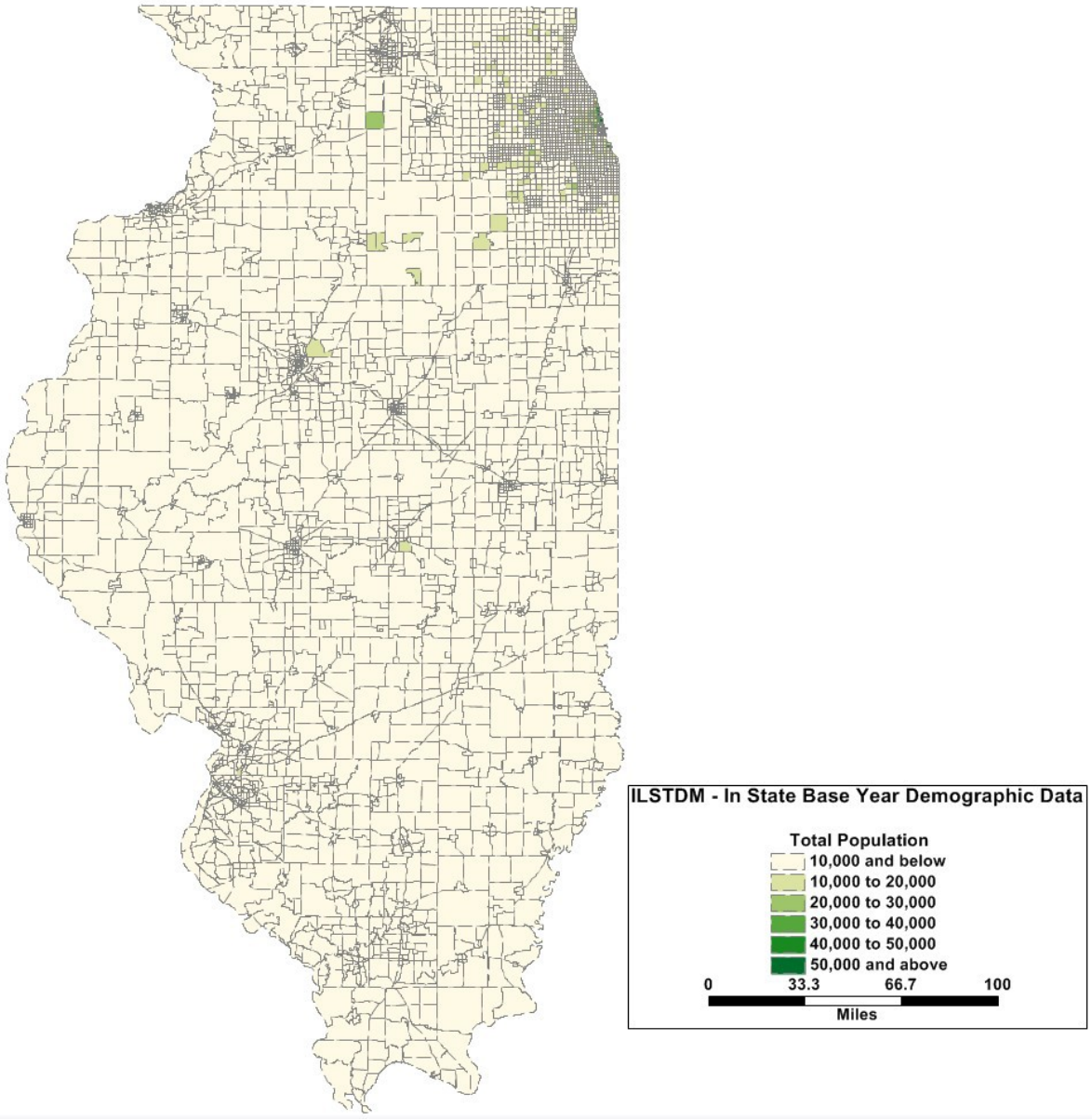


Figure 3-3: 2017 Base Year Total Population within the State of IL for the ILSTDM

Section 3 • TAZ and Socioeconomic Data Development

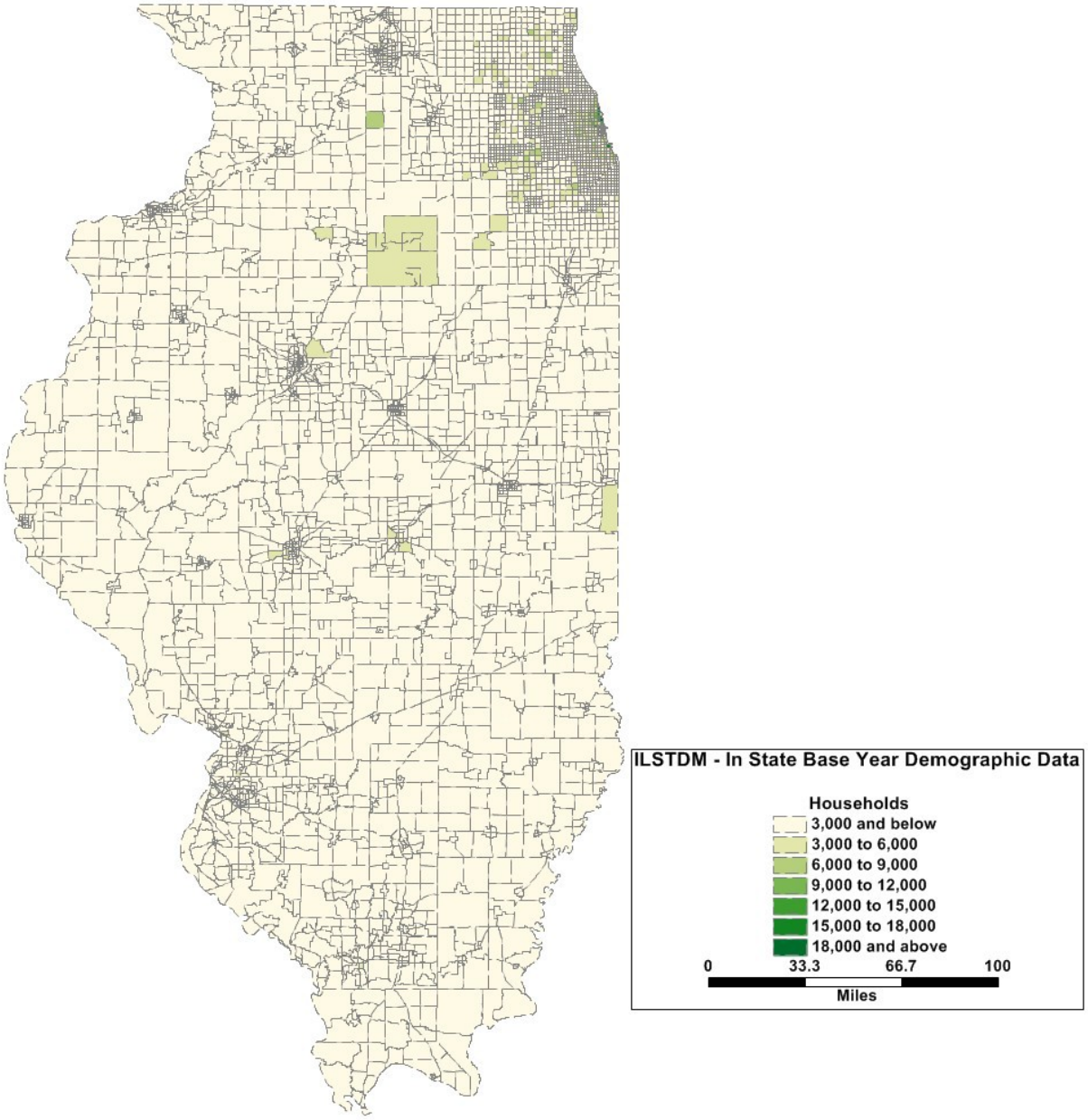


Figure 3-4: 2017 Base Year Households within the State of IL for the ILSTDM

3.1.3 Base Year Employment Data

This section discusses the development of employment data within IL and the review and quality checks performed to verify data accuracy. The employment data and sources used in the development of the data are listed in **Table 3-4**. The employment data was developed from Longitudinal Employer-Household Dynamics (LEHD) data with the most recent LEHD data available being 2015 data. The 2017 county control total for total employment were developed by forecasting the 2015 LEHD data to 2017, using Woods and Poole's county level annual growth rates between 2015 and 2017, for all counties within IL.

The specific LEHD data that was used in the development of employment by category data were the Work Area Characteristics (WAC) data at the census block geographic detail. The WAC data provides employment data and its characteristics at the work location census block.

Table 3-4: Employment Data Developed for the ILSTDM

Attribute	Data Source	Table
Total Employment	2015* LEHD Data	Work Area Characteristics (WAC)
Employment Categories by North American Industry Classification System (NAICS) Codes	2015* LEHD Data	Work Area Characteristics (WAC)
Agriculture, Forestry, Fishing and Hunting	2015* LEHD Data	Work Area Characteristics (WAC)
Mining, Quarrying, and Oil and Gas Extraction	2015* LEHD Data	Work Area Characteristics (WAC)
Utilities	2015* LEHD Data	Work Area Characteristics (WAC)
Construction	2015* LEHD Data	Work Area Characteristics (WAC)
Manufacturing	2015* LEHD Data	Work Area Characteristics (WAC)
Wholesale Trade	2015* LEHD Data	Work Area Characteristics (WAC)
Retail Trade	2015* LEHD Data	Work Area Characteristics (WAC)
Transportation and Warehousing	2015* LEHD Data	Work Area Characteristics (WAC)
Information	2015* LEHD Data	Work Area Characteristics (WAC)
Finance and Insurance	2015* LEHD Data	Work Area Characteristics (WAC)
Real Estate and Rental and Leasing	2015* LEHD Data	Work Area Characteristics (WAC)
Professional, Scientific, and Technical Services	2015* LEHD Data	Work Area Characteristics (WAC)
Management of Companies and Enterprises	2015* LEHD Data	Work Area Characteristics (WAC)
Administrative and Support and Waste Management and Remediation Services	2015* LEHD Data	Work Area Characteristics (WAC)
Educational Services	2015* LEHD Data	Work Area Characteristics (WAC)
Health Care and Social Assistance	2015* LEHD Data	Work Area Characteristics (WAC)
Arts, Entertainment, and Recreation	2015* LEHD Data	Work Area Characteristics (WAC)
Accommodation and Food Services	2015* LEHD Data	Work Area Characteristics (WAC)
Other Services [except Public Administration]	2015* LEHD Data	Work Area Characteristics (WAC)
Public Administration	2015* LEHD Data	Work Area Characteristics (WAC)

*Used Woods and Poole's county level annual growth rates between 2015 and 2017 to forecast to 2017.

The development of the in-state employment data in both the rural and CMAP area of the ILSTDM involves the development of a geographic crosswalk between the ILSTDM TAZs, and census blocks by allocating each census block to a zone. Once each block was allocated to the TAZ, the developed 2017 LEHD data for total employment and employment category by the North America Industry Classification System (NAICS) for each block was aggregated by TAZ.

Quality checks of the data were performed and include ensuring the sum of all employment categories for each zone was equal to the total employment in each TAZ and developing thematic maps for total employment to visually check high and low employment zones using google earth images to make sure it was consistent with the land use. In addition, TAZ employment were scaled to developed control totals.

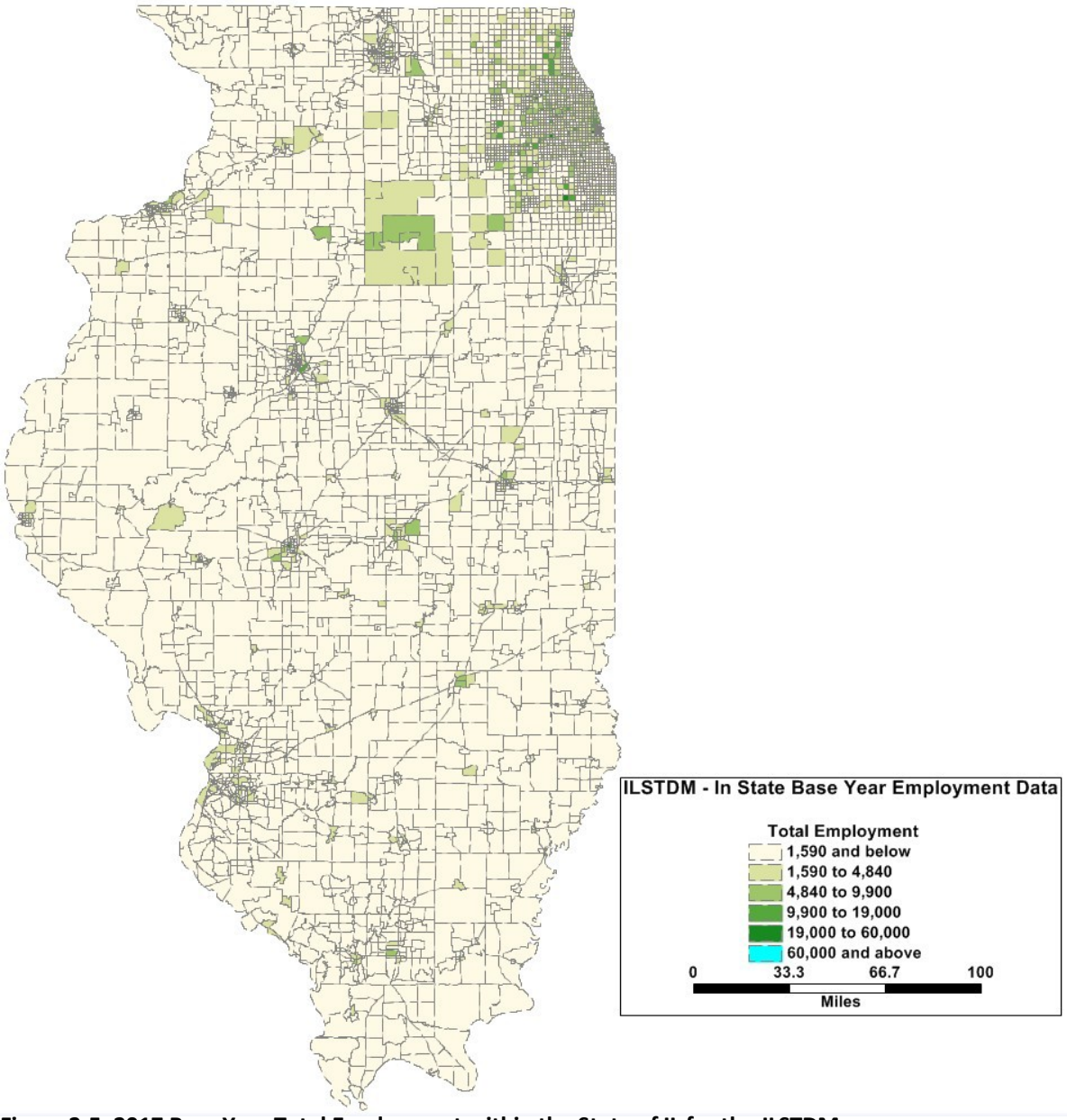


Figure 3-5: 2017 Base Year Total Employment within the State of IL for the ILSTDM

3.1.4 Adoption of Regional Models

This section discusses how regional model data is incorporated into the TAZs and how it was used to develop demographic and employment data for the in-state MPO zones.

For the MPO zones within IL, demographic and employment attributes for the TAZs were estimated following an approach which was consistent with the above methodology used to develop TAZs in the ILSTDM. None of the MPOs had socio-economic and employment information for 2017. The base year for all the MPOs with functional travel model ranged from 2010 to 2016. For the employment data, the majority of the MPOs did not have employment classified according to NAICS employment categories. The majority of the MPOs had employment information classified as general categories e.g., service, retail etc.

The sources used to develop the demographic and employment for all the MPO TAZs were consistent with the sources utilized for the rural area TAZs. Recommended population and

employment control totals were established from the 2017 ACS five-year estimates and LEHD data. Demographic and employment data in the existing MPO travel models were compared with the recommended control totals and checked for large discrepancies and inconsistencies. **Table 3-5** shows total recommended population for the ILSTDM and the available total population information available from the MPO travel models for some representative counties within the MPO boundaries.

Table 3-5: ILSTDM 2017 Total Population Compared to MPO Model Data

County	Urbanized Area	Recommended Total Population (2017)	Existing Total Population from MPO TDM (Base Year)
Boone	Rockford	53,638	53,654 (2015)
Champaign	Champaign-Urbana	207,946	201,081 (2015)
DeKalb	DeKalb-Sycamore	104,473	73,438 (2010)
Jo Daviess	Dubuque	22,046	11,765 (2015)
Peoria	Peoria	186,145	185,587 (2013)
Rock Island	Davenport-Rock Island	146,205	147,546 (2015)
Sangamon	Springfield	198,134	196,164 (2012)
St. Clair	St. Louis	264,433	267150 (2015)
Tazewell	Peoria	134,695	134,291 (2013)
Winnebago	Rockford	287,512	287,599 (2015)
Woodford	Peoria	38,942	38,825 (2013)
Madison	St. Louis	266,153	265,757 (2015)
Monroe	St. Louis	33,739	34,064 (2015)

Employment types distribution among the ILSTDM MPO TAZs were based on 2015 LEHD employment data. 2017 LEHD employment was obtained by estimating growth rates between 2015 and 2017 county level Woods & Poole total employment. **Table 3-6** shows the annual employment growth rates estimated from the Woods and Poole employment data for some representative counties with in the MPO planning boundaries.

Table 3-6: Annual Employment Growth Rate from Woods and Poole

County	Urbanized Area	Yearly Employment Growth Rate
Boone	Rockford	1.73%
Champaign	Champaign-Urbana	1.03%
DeKalb	DeKalb-Sycamore	1.41%
Jackson	Southern Illinois	0.23%
Jo Daviess	Dubuque	1.10%
Kankakee	Kankakee	1.27%
Macon	Decatur	0.94%
McLean	Bloomington-Normal	1.01%
Marion	Southern Illinois	0.29%
Peoria	Peoria	0.42%
Rock Island	Davenport-Rock Island	0.40%
Sangamon	Springfield	1.13%
St. Clair	St. Louis	1.00%
Tazewell	Peoria	0.10%
Vermillion	Danville	-0.27%
Winnebago	Rockford	1.08%
Woodford	Peoria	-0.20%
Franklin	Southern Illinois	1.60%
Henry	Davenport-Rock Island	1.43%
Madison	St. Louis	1.44%
Monroe	St. Louis	2.40%
Williamson	Southern Illinois	2.03%

3.2 Outside Illinois

The ILSTDM TAZ system was extended outside Illinois state border. The TAZ system outside Illinois is categorized into the halo area and the national area TAZs. The halo area TAZ system extends approximately 50 miles from IL state border. The national area TAZ system extends beyond the halo area and includes TAZs for the rest of the US.

3.2.1 Geography

The halo area TAZ boundaries mostly follow the county boundaries except in the CMAP region and at locations where the halo area overlaps with other regional models including East Central Intergovernmental Association, State Line Area Transportation Study, Bi-State Regional Commission, and the East-West Gateway Council of Government (MPOs). Boundaries of the CMAP model TAZ in the halo area were retained in the ILSTDM like what was done in the in-state portion for the CMAP area. The county boundaries where adjusted near the boundaries of other regional models where there were overlaps. There are 378 zones in the halo area.

Figure 3-6 shows the halo area TAZs highlighting the TAZs from CMAP and other regional models.

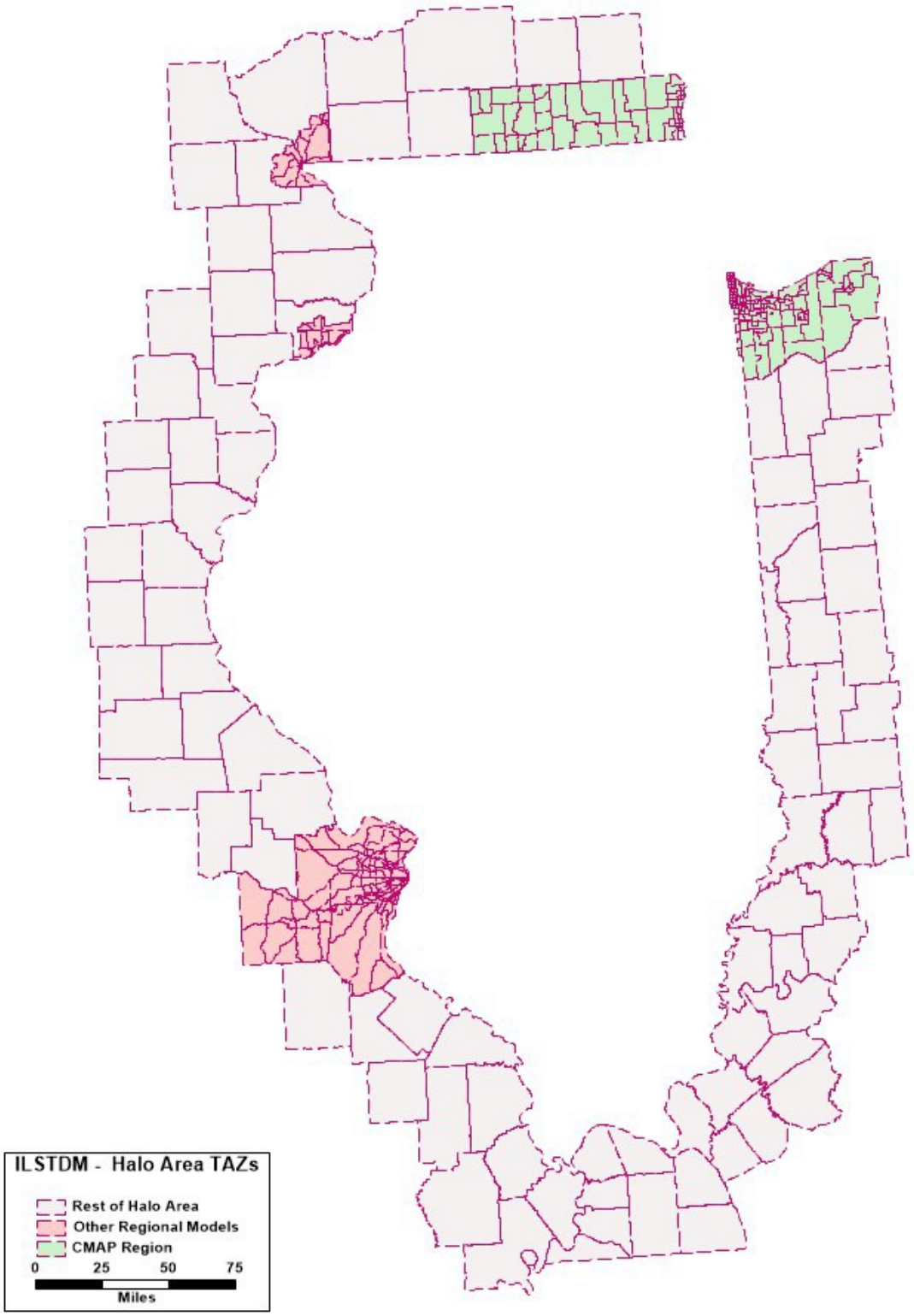


Figure 3-6: Halo Area TAZ Boundaries

Five MPOs (excluding CMAP) have their Metropolitan Planning Area (MPA) boundaries beyond the Illinois state boundary. These MPOs are shown in **Table 3-7**.

Table 3-7: List of MPOs with Boundaries in the Halo Area

Metropolitan Planning Organization	States with in Metropolitan Planning Area
East-West Gateway Council of Governments	Illinois, Missouri
Bi-State Regional Commission	Illinois, Iowa
Dubuque Metropolitan Area Transportation Study	Illinois, Iowa, Wisconsin
Rockford Regional Planning Council	Illinois, Wisconsin
Stateline Area Transportation Study	Illinois, Wisconsin

Existing TAZs from these MPO travel models were used to create the TAZs for the halo areas within these MPO boundaries. The Stateline Area Transportation Study TAZ boundaries were not available and as a result, census block group boundaries were used instead for the halo area TAZ development in the Stateline Area Transportation Study region of ILSTDM.

Existing MPO travel model TAZs were merged for creating the halo area TAZs. This resulted in 179 TAZs from other regional models created for the halo area.

The national level TAZ system extends from the border of the halo area to the rest of the US. FAF4 zone boundaries were used to develop the national TAZs of the ILSTDM. There are 118 zones in the ILSTDM at the national level. **Figure 3-7** shows the national level TAZ boundaries.

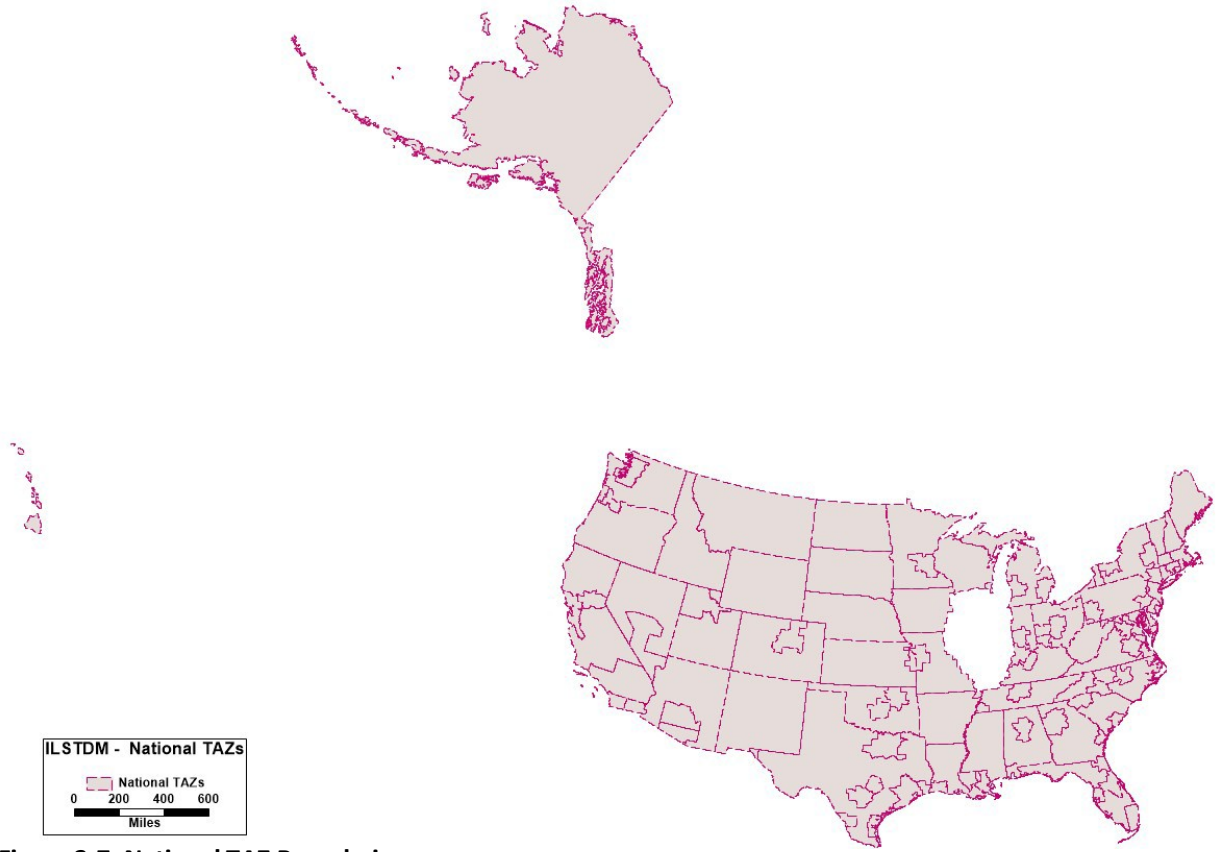


Figure 3-7: National TAZ Boundaries

3.2.2 Base Year Demographic Data

The base year demographic data was developed for both halo and national area TAZs outside IL. The 2017 ACS five-year estimates were used as the source of demographic data. Initially, county level control totals were developed for the halo and national TAZs. The county level control totals were aggregated or disaggregated to develop the data at the TAZ level outside of IL. The 2010 census block level population and household data were used to develop the disaggregation factors at the areas outside the CMAP region in the halo area. In the CMAP region, the demographic data from the CMAP model was used to develop the disaggregation factors and used to allocate the county level data at the block level or at the CMAP TAZ level. At non-CMAP areas, the block level data was then aggregated to the TAZ level to develop the data at the TAZ level. The demographic variables for the halo and national areas along with the data sources are listed in **Table 3-8** and **Table 3-9**, respectively.

Table 3-8: Halo Area TAZ Demographic Variables

Variable	Description	ACS Tables
TOTPOP	Total Population	B01003
HHPOP	Household Population	B11002
GQPOP	Group Quarter Population	B26001
HH	Total Households	B11011 or B11016
HHSIZE	Average Household Size	S1101
HHINC	Median Household Income	S1901 or S1902 or S1903
HHWRK	Average Household Workers	B08202
HHVEH	Average Household Vehicles	B08201
SENHH	Percent of Household Seniors	S1101
K12ENR	K-12th Grade School Enrollment	S1401
UNVENR	College/University Enrollment	S1401

Table-3-9: National Area TAZ Demographic Variables

Variable	Description	ACS Tables
TOTPOP	Total Population	B01003
HHPOP	Household Population	B11002

The TAZ level demographic data were reviewed for accuracy. The estimated average household size, median household income, average workers per household, and average number of vehicles per household were checked to make sure they were reasonable. Thematic maps of population shown in **Figure 3-8** and **Figure 3-9** were developed to check the concentration of the population.

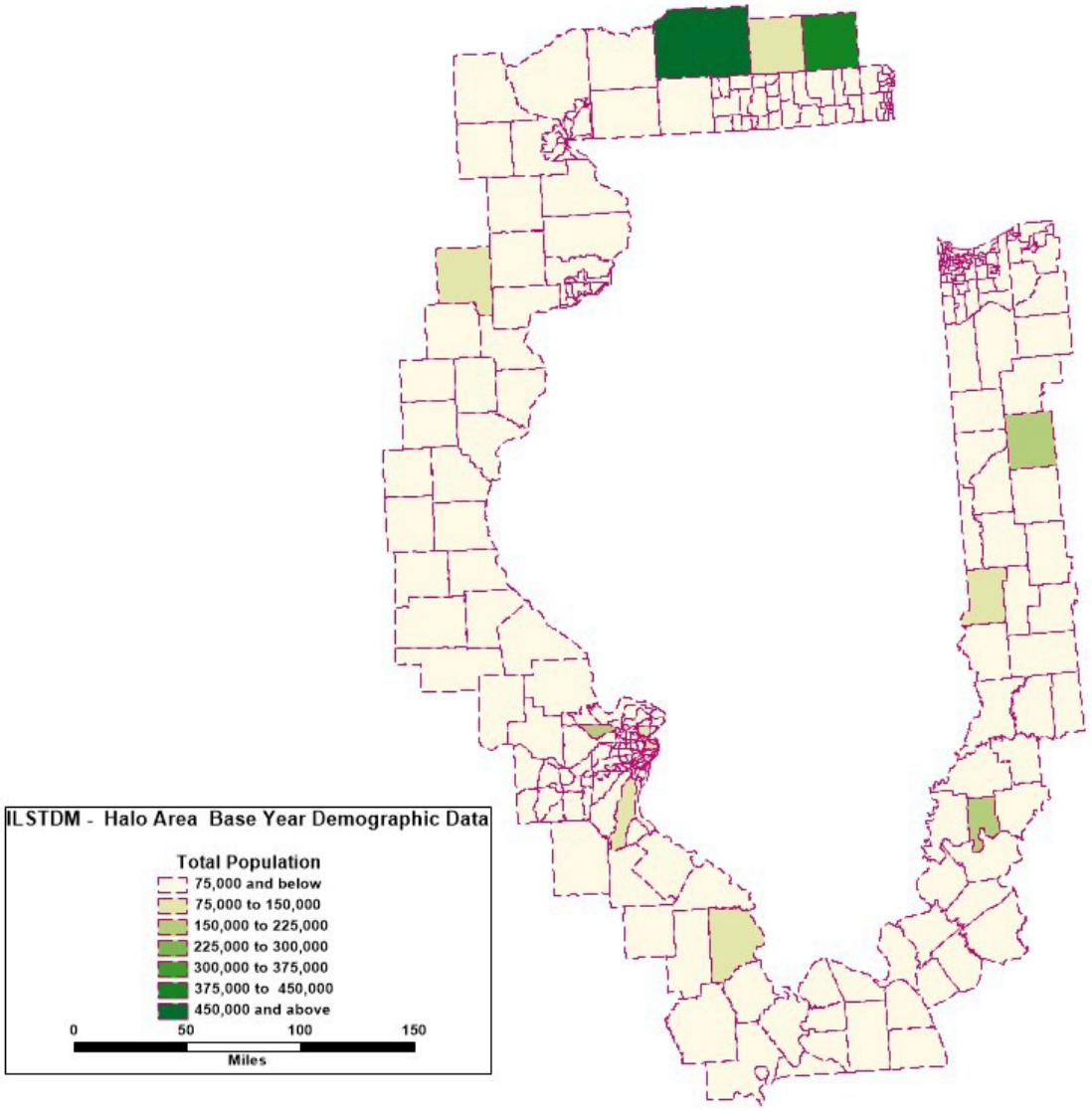


Figure 3-8: 2017 Base Year Total Population in the Halo Area of the ILSTDM

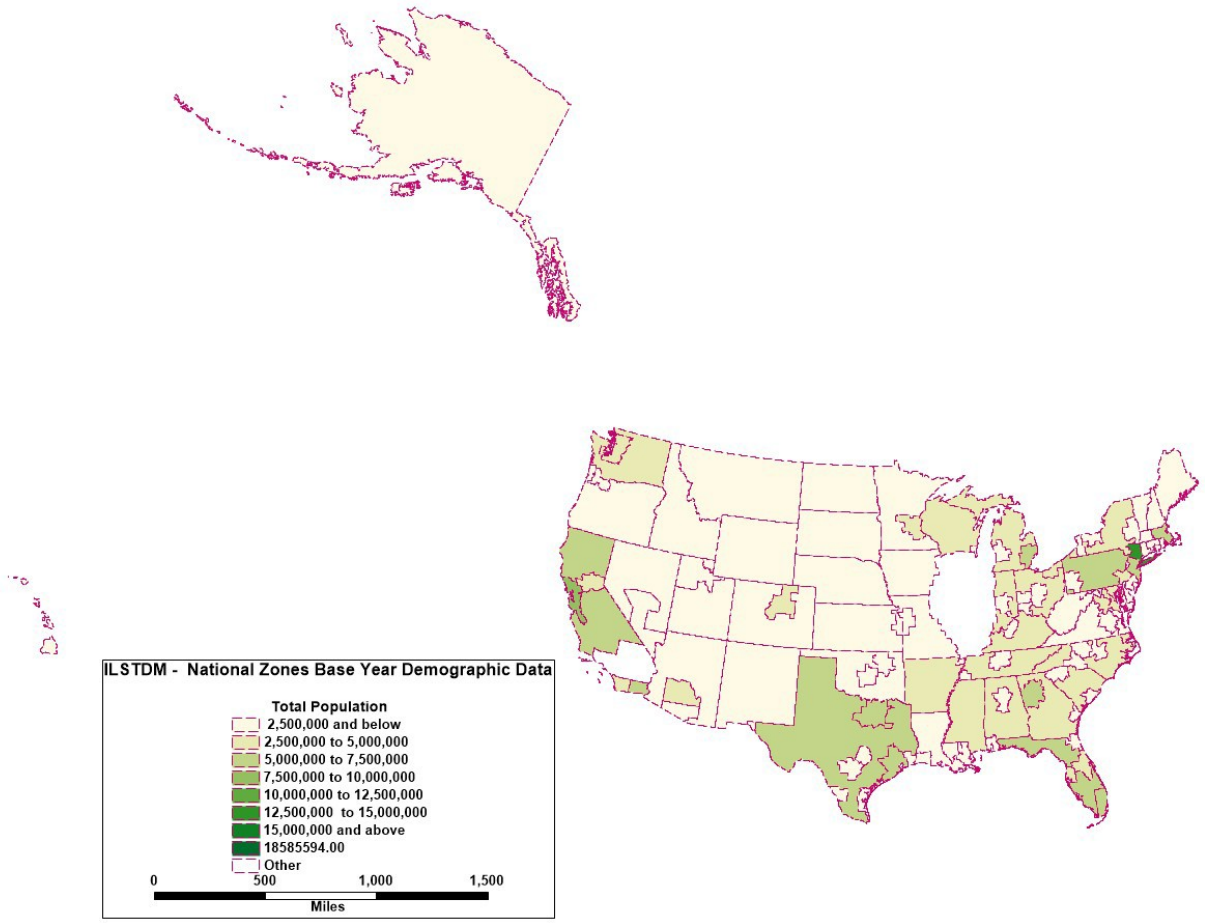


Figure 3-9: 2017 Base Year Total Population in the National Area of the ILSTDM

3.2.3 Base Year Employment Data

Base year employment data was developed for both halo and national area TAZs using LEHD data. The most recent LEHD data was available is for the year 2015. The growth in employment between year 2015 and 2017 was estimated from Woods and Poole data. The LEHD data is available at census block level. The block level data was aggregated to develop employment at the TAZ level for both the halo and national areas in the ILSTDM. The employment variables for halo and national area TAZs along with the data source are listed in **Table 3-10**.

Table 3-10: Employment Variables for the Halo and National Area TAZs in the ILSTDM

Variable	Description	LEHD Table
TOTEMP	Total Employment	**_wac_S000_JT00_2015.csv
NAICS sector 11	Agriculture, Forestry, Fishing, Hunting	**_wac_S000_JT00_2015.csv
NAICS sector 21	Mining, Quarrying, Oil-Gas Extraction	**_wac_S000_JT00_2015.csv
NAICS sector 22	Utilities	**_wac_S000_JT00_2015.csv
NAICS sector 13	Construction	**_wac_S000_JT00_2015.csv
NAICS sector 31-33	Manufacturing	**_wac_S000_JT00_2015.csv
NAICS sector 42	Wholesale Trade	**_wac_S000_JT00_2015.csv
NAICS sector 22-45	Retail Trade	**_wac_S000_JT00_2015.csv
NAICS sector 48-49	Transportation and Warehousing	**_wac_S000_JT00_2015.csv

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Variable	Description	LEHD Table
NAICS sector 51	Information	**_wac_S000_JT00_2015.csv
NAICS sector 52	Finance and Insurance	**_wac_S000_JT00_2015.csv
NAICS sector 53	Real Estate and Rental and Leasing	**_wac_S000_JT00_2015.csv
NAICS sector 54	Professional, Scientific, and Technical Services	**_wac_S000_JT00_2015.csv
NAICS sector 55	Management of Companies and Enterprises	**_wac_S000_JT00_2015.csv
NAICS sector 56	Administrative, Waste Management and Remediation	**_wac_S000_JT00_2015.csv
NAICS sector 61	Educational Services	**_wac_S000_JT00_2015.csv
NAICS sector 62	Health Care and Social Assistance	**_wac_S000_JT00_2015.csv
NAICS sector 71	Arts, Entertainment, and Recreation	**_wac_S000_JT00_2015.csv
NAICS sector 72	Accommodation and Food Services	**_wac_S000_JT00_2015.csv
NAICS sector 81	Other Services [except Public Administration]	**_wac_S000_JT00_2015.csv
NAICS sector 92	Public Administration	**_wac_S000_JT00_2015.csv

Similarly like the base year population data, thematic maps were developed to check the concentration and reasonableness of the developed employment data for the halo and national areas of the ILSTDM and are shown in **Figure 3-10** and **Figure 3-11**, respectively. These thematic maps show higher concentrations employment in urban areas which is intuitive.

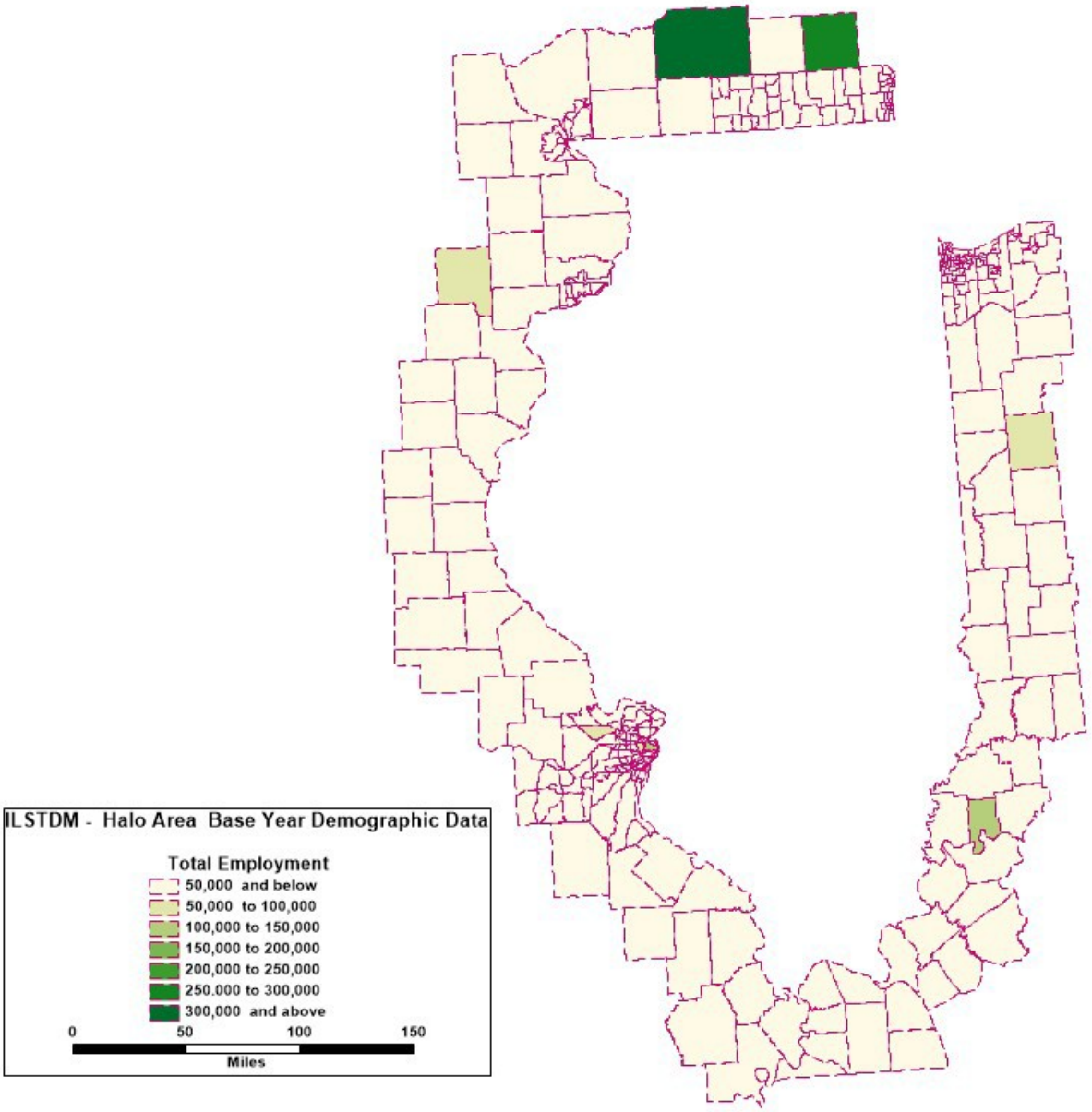

Figure 3-10: 2017 Base Year Total Employment in the Halo Area of the ILSTDM

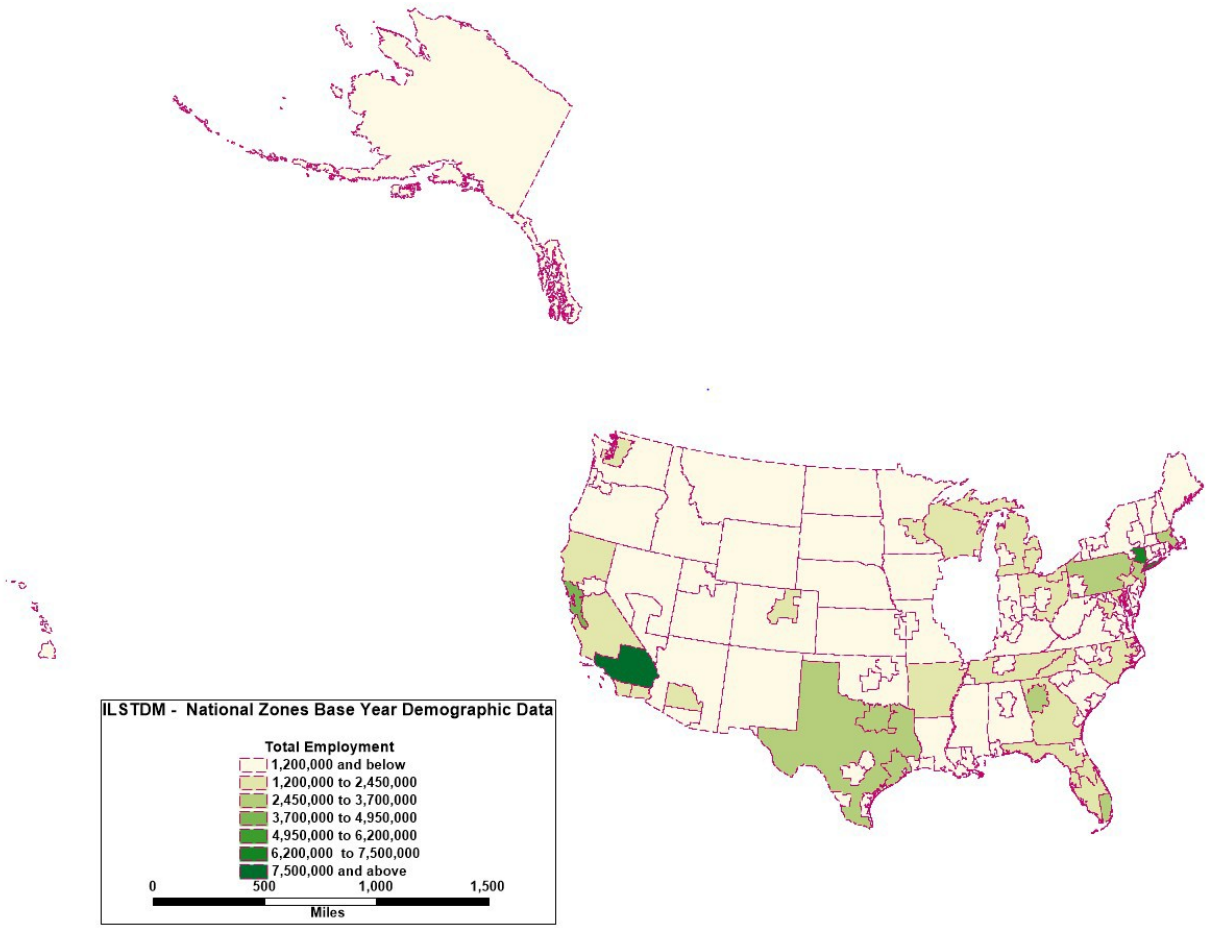

Figure 3-11: 2017 Base Year Total Employment in the National Area of the ILSTDM

3.2.4 Adoption of Regional Models

This section discusses how regional model data is incorporated into the halo area TAZs and socioeconomic data. The approach used for estimating the demographic and employment data for MPO zones within the halo area is like what was used for the MPO zones in-state of the ILSTDM; please refer to Section 3.1.4 of the report for further information.

3.3 TAZ Identification Numbers

Once the TAZ geographies were developed, TAZ IDs were developed which considers the state, Illinois State Department of Transportation (IDOT) districts, county and geographic location of the TAZ. Different numeric identification conventions are used depending on the location of the TAZ geographically. For the National TAZ IDs, a starting 2-digit number of "99" was combined with a 3-digt code of "000", and a 3-digit FAF4 zone ID number. It should be noted that FAF4 zones IDs can be 2-digit or 3-digit and so to obtain a consistent 3-digit number to be used in the national TAZ ID naming convention, all 2-digit FAF4 zone IDs in the national area of the ILSTDM were preceded with the number "0". The TAZ IDs are based 7-8 numbers as shown in **Table 3-11**.

Table 3-11: TAZ Identification Numbers

TAZ Digit	Description	Applicability
Digits 1-2 (##000000)	One-digit IDOT District Number (1-9)	In state TAZs
	Two-digit state FIPS Code	Halo Area TAZs
	Fixed two-digit number - 99	National TAZ
Digits 3-5 (00###000)	Three-digit county FIPS Code	In state and Halo TAZs
	Fixed Three-digit number - 000	National TAZ
Digits 6-8 (00000###)	Three-digit TAZ number based on the rank of its Latitude	In state and Halo TAZs
	Three-digit FAF4 zone ID	National TAZs

Section 4

Best Practices

It should be noted that though this chapter attempts to illuminate best practices for developing a statewide travel demand model, it can not be emphasized with more certainty that what practices and methodology would fit one agency may or may not fit the other. What is quixotic for one organization, may be unpragmatic to the other. However, the most effective model would arguably the one that addresses agency's needs promptly, is cost-effective and can be applied creatively and competently. Therefore, practices mentioned below works for Illinois Statewide Travel Demand model and anyone grasping and learning from these should keep the appropriate context and applications in mind. Some of the practices that came into light while working on the Illinois Statewide Travel Demand Model are following:

Traffic Analysis Zones

Traffic Analysis Zones (TAZs) represent the quintessential unit of geography from which people travel to and from. TAZs are made by referencing spatial geography and demographic characteristics of the region. They represent the origin and destination of the travel activity within the region. All activities are aggregated into zones and then are further simplified to centroid connectors. Hence, if TAZs thus created and refined according to the real-life like scenarios, would simulate real-life like travel patterns and behavior. Therefore, one should keep the following practices in mind when creating and delineating TAZs :

- **Zone Size and Quantity:** Population threshold selected for Illinois Statewide travel demand model is 3,000. Hence TAZs having population more than 3,000 were split into smaller geographies. Smaller the TAZs, more accurate the forecasts might be (Systematics, 2007). However, having more TAZs require more detailed data. Therefore, close attention should be given while splitting TAZs. If TAZs split following Census Block or Block Groups boundaries, modelers can use data provided by the Census, otherwise must develop an ad-hoc methodology of splitting Households, employment centers etc. according to geo-spatial boundaries.
- **Physical Geography:** This refers to any feature that may act as a barrier and may affect free flowing movement. Hence, TAZs should be delineated and followed according to the
    1. Natural Barriers: Lakes, Ponds, Rivers
    2. Human-Made Barriers: Freeways.

  This is done as these boundaries reflect realistic access from TAZ centroid to node on the network reflect on real-life like travel behavior. These centroids represent the activity centers of TAZs and access via local roads and/or driveways. Having a Centroid Connector passing through the barrier conflicts with the assumption of free movement

- **Irregular Shape:** Irregular shape can cause aggregation of trips onto the network unrealistically. If TAZs are in rectangular shape, longer centroid connectors would not be assigned more trips due to link length (Systematics, 2007). Therefore, it becomes necessary to break down irregular shaped TAZs into 4-5 sided polygonal shapes.
- **Separating Town Centers:** Often in rural areas, TAZs encapsulate town centers with sparsely populated areas. Often these TAZs would have productions(Home) and attractions(employment centers) in the same TAZ. This results in trips that are aggregated and can significantly be eliminated due to Intrazonal Travel. As majority of the trips are short enough to begin and end in the same zone. Hence, one should separate the town centers from sparsely populated areas.

Socio-Economic Data

- Economic forecasts for broad areas and industry categories were used to generate estimates of future socioeconomic activities within the modeled area. These appear to be done most often at the statewide or sub-state region level, allocating them further to counties or TAZs based upon existing zonal employment estimates, land use data, accessibility, and other measures.
- Firms and employment are most often coded to the two-digit North American Industrial Classification System (NAICS) codes (USCB 2016). Some states use greater detail for dominant industries within the state and combine those found less frequently. Others aggregate the two-digit NAICS into families of firm type (e.g., service, retail, and manufacturing). Those choices of spatial and industry resolution appear to largely hinge upon data availability, but in the Illinois STDM, each TAZ has a measure of employment, employment projections, and their breakdowns according to NAICS sector, which helps in gaining fine detail of firms or employers by sector.
- Most states use external economic forecasts in their work. The source of these forecasts varies widely, as does the amount of work going into them. Many use forecasts created by the state economist or other state agencies charged with developing them. Others rely upon third parties; for the Illinois STDM, Woods and Pole (third party) data was used to realign the projection percentages.
- As most of the data available to use was of the year 2015, all counties' projection estimates (calculated accordingly with population and employment estimates) were calculated for the base year 2017 (ILSTDM) using Woods and Pole data. These estimates were further broken down into TAZs (or Census Blocks, wherever, applicable) depending on the proportion of their total to the county total and then aggregated back to check their validity

Geography

- A definitive best practice for integrating urban and statewide zones remains elusive. In some cases, groups of urban zones are nested within each statewide zone. Equivalency tables are used to transfer information from one zone system to the other if needed. In other cases, processes for defining unique statewide zones are used. The process for combining different polygon coverages using GIS software is relatively straightforward. This reduces, if not eliminates, the need to keep the boundaries of urban and statewide zones synchronized.
- The Illinois STDM extends well beyond the state borders, usually with decreasing levels of detail as distance from the state increases. It is common to represent the area within the state and a halo zone around it with TAZs that aggregate to counties and census geographies. Outside of the state, successively coarser political and low-resolution census geographies are used to represent distant areas.

Miscellaneous

- The tension between the number of zones and the computational burden is felt more acutely in statewide modeling. In smaller states, it might be possible to "stretch" the urban models to cover the remainder of the modeled area, with no loss of resolution or precision. However, this is not practical in most cases, for the run time of most models increases exponentially as the number of zones increase.

- Even on the most efficient hardware available today, advanced models with 7,500 or more TAZs are cumbersome and slow, with formidable resources required for developing and maintaining data at that level of geography. Thus, the Illinois STDM aggregates the zone systems in between 5,000 and 6,000 TAZs as it helps in significantly reducing the computational burden faced by models or developers.

- The FAF(Freight Analysis Framework) is an excellent and important data source for statewide models despite some limitations. Its availability has fundamentally changed the way most states approach freight modeling. Some still rely upon third-party data, but most use the FAF today. Its transparency, greater level of detail, availability of forecasts, and online documentation make it easy to incorporate into statewide models.

  Aforementioned practices represent a critical approach in developing a Statewide Travel Demand Model that are par the course, context dependent. And if adopted, by organizations can help in forecasting travel demand in real-life terms.

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